

# Assessing Spectrum of Fractures in Elderly; Perspective on Tertiary Care Hospital of Nepal

Parajuli B, Sharma R, Kayastha SR, Thapa J, Shrestha R, Shrestha D

Department of Orthopedics,  
Dhulikhel Hospital, Kathmandu University Hospital,  
Dhulikhel, Kavre, Nepal.

## Corresponding Author

Bikash Parajuli  
Department of Orthopedics,  
Dhulikhel Hospital, Kathmandu University Hospital,  
Dhulikhel, Kavre, Nepal.  
E-mail: bikash480@gmail.com

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## ABSTRACT

### Background

There is an increasing life expectancy and a surging elderly population in the last few decades, leading to a higher incidence of fractures in the elderly. The health care of the elderly in Nepal is below par and there are no studies done to evaluate the spectrum of fractures in the elderly.

### Objective

To evaluate the demographical and epidemiological aspects of fractures in the elderly ( $\geq 65$  years) presenting to a tertiary care hospital in Nepal in a 15 years' timeline.

### Method

This study was a retrospective epidemiological study conducted in the Department of Orthopedics, Dhulikhel Hospital, Kathmandu University Hospital (DH, KUH), Nepal. The patients of age  $\geq 65$  years having traumatic injuries, admitted in the orthopedics ward from 2006 January to 2020 December were included. Patient demographics, site of injury, fracture incidence, mechanism of injury, hospital stay duration, and mode of treatment (surgical/ conservative) were evaluated.

### Result

Of the 787 patients with an average age of  $73.65 \pm 7.5$  years, 54% were females. Peritrochanteric fracture was the most common fracture (29.4%) followed by spine (18.3%). The most common mechanism of injury was fall on the labeled ground (38.6%). The incidence of fragility fractures (peri-trochanteric, proximal humerus, spine, and distal radius) was increasing with age.

### Conclusion

Females, peritrochanteric fractures, and trivial trauma are the most common occurrences for fractures in elderly. The incidence of fragility fractures is increasing with age but the overall incidence of fractures compared to other studies is low. Higher incidences of road traffic accidents (RTA) and compound fractures among the elderly are serious public health concerns that highlight the importance of primary preventive measures.

## KEY WORDS

*Elderly, Fracture, Incidence, Nepal*

## INTRODUCTION

The improved lifestyle and health facilities have helped in increasing life expectancy and surging the elderly population in the last few decades. This has also increased the incidence of fractures in the elderly population which varies in different parts of the world.<sup>1,2</sup> Fragility fractures and other fractures in the elderly are significant causes of morbidity and mortality in the elderly population. It adds to the financial burden due to staggering costs for treatment and the utilization of a huge amount of human resources.<sup>3</sup> There are studies that highlight the changing incidence of fragility fractures of the proximal humerus, distal radius and ulna, pelvis, and proximal femur.<sup>1-6</sup> However, there are limited studies evaluating the overall spectrum of fractures in the elderly, and information about the incidence of old age fractures is scarce.<sup>3,7</sup>

Overall health care of the elderly in Nepal is still below par due to a lack of proper governmental health and social security systems for the elderly.<sup>8</sup> Despite the presence of a few governmental and community-based programs for elderly care; the successful implementation and overall effectiveness of these programs are doubtful which adds up to the paucity of information related to fractures in the elderly. Moreover, there are limited studies in fragility fractures in Nepal and not a single study highlights the overall spectrum of fractures in the elderly.<sup>9</sup> Hence, this study evaluates the demographical and epidemiological aspects of fractures in the elderly ( $\geq 65$  years) presenting to a tertiary care hospital in Nepal over a 15 years' timeline.

## METHODS

This is a single centered retrospective epidemiological study conducted in the Department of Orthopedics, Dhulikhel Hospital, Kathmandu University Hospital (DH, KUH), Nepal.

The elderly patients (age  $> 65$  years) who had traumatic bony or soft tissue injury at any site of any morphology, admitted in the orthopedics ward from January 2006 to December 2020 were included in the study. Pathological fractures, non-traumatic pathologies, and patients presenting to the emergency department but not enrolled in the hospital for further treatment were excluded.

DH, KUH is the only tertiary care hospital treating adult trauma in Kavre, Sindhupalchowk, Dolakha, Ramechhap, Bhaktapur, and Sindhuli districts. According to the Nepalese government census of 2011, the population of  $\geq 65$  years in the above-mentioned districts was 1,657,753. Individual districts' annual growth rate was used to calculate the population from 2006 to 2020 in each district. Further, the average population in each age group was calculated using the average total population from 2006 to 2020. The yearly incidence of each fracture in patients who are  $\geq 65$  years per 100,000 populations was hence evaluated using the formula: Incidence of a fracture in a particular age group

= (New Cases) / (Population in a particular age group x Timeframe).

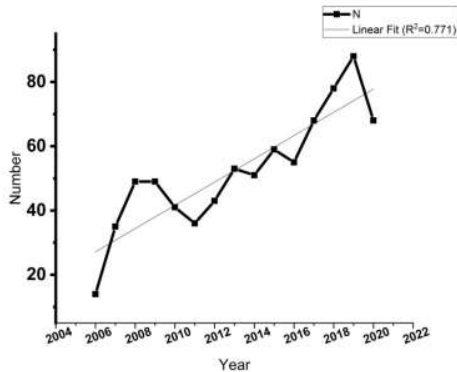
Patient demographics, site of injury, incidence of each fracture in different age groups, mechanism of injury, hospital stay duration, and mode of treatment (Surgical/Conservative) were the major outcomes evaluated. Olecranon and radial head fractures were categorized as fractures around elbow. Phalangeal, metacarpal, and carpal fractures were categorized as fractures of hand. Peritrochanteric fracture included neck of femur, intertrochanteric, and sub-trochanteric fractures. Tibial diaphyseal fractures included fractures of the tibial and fibular diaphysis. Fibular fractures included fractures of the fibula not involving the proximal tibia, tibial diaphysis, or ankle. Fractures of foot and ankle included bimalleolar fractures, and fractures of tarsals/metatarsals. The other fractures were categorized according to accepted clinical criteria. Structured coded data and unstructured narrative data of included patients were extracted from the electronic health record (EHR) of DH/KUH. For the patients with missing data from EHR, non-electronic hospital records (Patient files, scanned documents, and images [x-rays, CT scans, and MRI]) were included.

The collected data were entered and analyzed using IBM SPSS version 25.0 (SPSS Inc., Chicago, IL, USA). The normality of continuous variables was checked using the Kolmogorov-Smirnov test. The continuous variables with normal distribution were presented as mean  $\pm$  standard deviation (mean  $\pm$  SD). Non-normal variables were reported as median (Interquartile range [IQR]). Linear regression analysis of the number of patients every year was done to evaluate the linear fit. Spearman correlation test was done to evaluate the correlation between increasing age and the incidence of all types of fracture. Correlation between the age of the patient and duration of hospital stay was done by using Pearson's correlation test. One way Analysis of variation (ANOVA) was done to evaluate the association between fracture location and age of the patients. Similarly, Fisher's Exact test was applied to evaluate the association between the mechanism of injury and patients aged below or over 80 years. A value of  $p < 0.05$  was considered significant. Complete case analysis was done to address missing data in the study.

## RESULTS

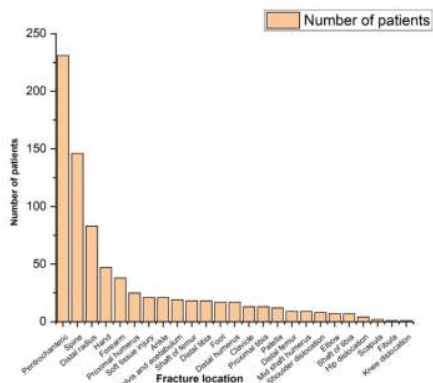
There were a total of 787 patients included in the study. The linear regression comparing the number of patients admitted in respective years showed an overall positive linear fit ( $R^2=0.771$ ), however the number of patients dropped by 23% in 2020 owing to the COVID pandemic (fig. 1). Four hundred and twenty-five (54%) patients were females (M: F: 0.85:1) with relatively higher percentage of females in the 70-74 and the 80-84 age category. The mean age of the patients was  $73.65 \pm 7.5$  years. There was

no significant difference between the mean ages of males ( $73.24 \pm 7.7$  years) compared to that of females ( $73.99 \pm 7.4$  years). The most commonly involved age groups were 65-69 and 70-74 years (241 patients in each group).



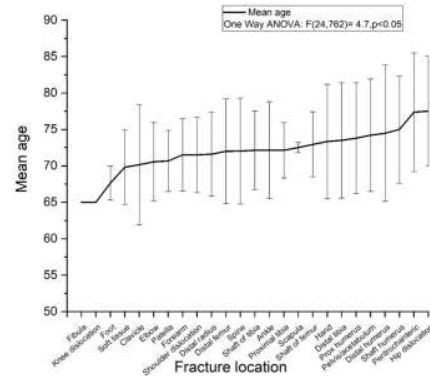
**Figure 1. Year wise distribution of patients**

Lower extremity was involved in 385 (48.9%) patients followed by upper extremity in 247 (31.4%) patients. Peritrochanteric fracture was the most common fracture which was found in 231 (29.4%) patients followed by spine in 144 (18.3%), and distal radius fracture in 83 (10.5%) patients (fig. 2). Ninety-eight patients (54%) above the age of 80 years had peritrochanteric fracture ( $p < 0.05$ ). Evaluating the incidence of spine fracture in elderly, 122 patients (20.13%) of 606 patients below the age of 80 had spine fracture which was higher compared to patients above 80 years (24 patients/13.26%).



**Figure 2. Number of patients according to fracture location**

Fractures of proximal tibia, tibial diaphyses, foot, elbow, and fibula occurred exclusively in patients below 80 years of age. Similarly, patients below the age of 80 years had higher incidence of fractures of clavicle (2% vs. 0.5%), shoulder dislocation (1.1% vs. 0.5%), forearm (5.6% vs. 2.2%), distal radius (11.2% vs. 6%), pelvis and acetabulum (2.6% vs. 0.5%), and femoral diaphysis (2.6% vs. 1.1%). However, fractures of proximal humerus, distal humerus, hand, distal femur, distal tibia and ankle were equally distributed among both the age groups. One way ANOVA test for comparing mean age between the groups of patients with different injury locations showed a statistical difference  $F(24,762) = 4.7, p < 0.05$  (fig. 3).



**Figure 3. Mean age of the patients in different fracture spectrum**

The most common mechanism of injury was fall on labeled ground (38.6%) followed by fall from height (29.9%), and road traffic accidents (RTA) (24.7%). One hundred and fifteen patients (63.5%) above the age of 80 years had injury related to low energy trauma (fall from standing height); whereas, 168 patients (40%) having high velocity injury (fall from height and road traffic accidents) were in the younger age group (65-69 years) ( $p < 0.05$ ). Moreover, thirty two (4.1%) fractures were compound. Majority of compound fractures (93.7%) occurred in the patients below 80 years and there were no compound fractures in the patients above 85 years ( $p < 0.05$ ). Five-hundred and forty four (69.1%) patients were operated, 230 (29.2%) patients were managed conservatively, and 13 (1.7%) patients left against medical advice. Among the conservatively managed patients, majority (48.3%) had spine fracture.

The median hospital stay was five days (IQR: three to eight). There was a weak negative correlation between the age of the patient and the duration of hospital stay. Patients with compound fractures stayed one day more in the hospital as compared to patients with closed fractures. Fisher's exact test was applied to evaluate the correlation of age with the site of injury. It showed higher chances of lower extremity injury with increasing age ( $p = 0.005$ ). Spearman correlation was done to evaluate the association of specific fracture incidence with the age of the patients. The incidence of peritrochanteric, proximal humeral and, fracture of hand was increasing with age ( $p < 0.05$ ). However; the incidence of other fragility fractures (spine and distal radius fracture), though have a positive correlation with age, is not statistically significant. Fractures of foot and ankle (bimalleolar fracture, tarsal, and metatarsal fracture) showed a statistically significant negative correlation with age (Table 1).

**DISCUSSION**

Our study showed an increase in fragility fractures with age. There was a female predominance with higher percentages of trivial trauma leading to fractures. RTA is also one important mechanism of injury in elderly contributing to compound fractures. However, the overall incidence of all fracture types was low.

**Table 1.** Spearman correlation of the incidence of all types of fracture in patients per year/100,000 population above 65 years in five-year ranges

Fracture location	65-69	70-74	75-79	80-84	85-89	>90	R value	P value
Peritrochanteric	5.5	14.5	15.1	45.4	43.9	151.5	0.94	0.00
Spine	9.6	10.3	8.0	9.6	15.9	31.9	0.64	0.17
Distal radius	5.1	5.9	6.4	7.2	2.0	8.0	0.43	0.40
Hand	3.0	2.3	3.2	4.8	6.0	15.9	0.94	0.00
Fore-arm	2.3	4.0	1.2	3.2	0.0	0.0	-0.70	0.12
Proximal Humerus	1.0	2.1	1.6	1.6	6.0	8.0	0.81	0.05
Ankle	1.2	1.9	0.8	3.2	0.0	0.0	-0.58	0.23
Pelvis/acetabulum	0.8	1.9	1.6	0.8	2.0	8.0	0.70	0.12
Shaft of Femur	0.3	2.6	1.2	0.8	2.0	0.0	-0.26	0.62
Distal tibia	1.2	0.9	0.8	2.4	4.0	0.0	-0.09	0.87
Distal humerus	1.3	0.5	1.2	0.8	0.0	23.9	0.03	0.96
Foot	2.0	1.2	0.0	0.0	0.0	0.0	-0.85	0.03
Soft tissue injury	1.3	1.4	1.2	0.0	0.0	0.0	-0.88	0.02
Patella	1.3	0.9	1.2	0.8	0.0	0.0	-0.93	0.01
Proximal Tibia	0.5	0.9	2.4	0.0	0.0	0.0	-0.70	0.12
Clavicle	1.2	0.9	0.4	0.0	0.0	8.0	-0.12	0.83
Mid Shaft Humerus	0.2	0.9	0.8	0.8	0.0	8.0	0.23	0.66
Distal Femur	0.7	0.7	0.0	0.8	2.0	0.0	0.03	0.96
Shoulder dislocation	0.3	0.9	0.4	0.8	0.0	0.0	-0.58	0.23
Shaft of tibia	0.3	0.7	0.8	0.0	0.0	0.0	-0.70	0.12
Elbow	0.7	0.0	1.2	0.0	0.0	0.0	-0.54	0.27
Hip Dislocation	0.0	0.5	0.0	1.6	0.0	0.0	-0.14	0.80
Scapula	0.0	0.5	0.0	0.0	0.0	0.0	-0.39	0.44
Fibula	0.2	0.0	0.0	0.0	0.0	0.0	-0.65	0.16

There is a progressive increment of elderly patients with fracture every year ( $R^2=0.771$ ) which coincides with the expansion of orthopedics facilities in our hospital with

time. However, the acute drop in number of patients by 23% in 2020 can be attributed to long duration lockdown during COVID pandemic which led to difficulties for patients to seek hospital care. The average age of the patients in this study is  $73.0 \pm 7.5$  years which is lesser than in the study done by Zhu et al. (76.2 years).<sup>10</sup> This difference in the average age between patients could be due to the difference of life expectancy between Nepal (70.48 years as of 2018) and China (76.7 years as of 2018). Besides, there was a female predominance in our study which is a similar finding to the study done by Zhu et al.<sup>10</sup> and Court-Brown et al.<sup>3</sup> With increasing age females have higher tendency to develop osteoporosis leading to higher rates of insufficiency fractures compared to males. This could be the explanation for higher occurrence of old age fracture among females in our study.

This study showed peritrochanteric fractures to be most commonly occurring (29.3%) followed by fractures of the spine (18%) which is similar to the study by Zhu et al. where peritrochanteric fractures and spine fractures accounted for 58% and 7.5% of patients respectively.<sup>10</sup> The study by Court-Brown et al. has shown an increased incidence of fragility fractures (peritrochanteric, proximal humerus, distal radius), clavicle fracture, and humeral diaphyses fracture, distal humerus fracture, and proximal tibia fracture with increasing age.<sup>3</sup> Court-Brown et al. in another study had examined two prospectively collected databases 10 years apart for evaluating fractures that are becoming more common in  $\geq 65$ -year-old patients.<sup>11</sup> They concluded that in older female patients, fractures of the clavicle, finger, phalanges, ankle and metatarsus are increasing in incidence. In males, there is an increasing incidence of fractures of the proximal humerus, distal humerus, metacarpus, pelvis, femoral diaphysis, distal tibia, and ankle. Though our study has not evaluated the incidence for both sexes separately, the incidence of peritrochanteric fracture, proximal humerus fracture, pelvis/acetabulum fracture, and hand fracture showed a high positive correlation with age ( $R$ -value  $> 0.7$ ).

Trivial trauma related fractures were the most common (38.6%) in our study which is relatively low compared to the study by Court-Brown et al. (90.8%) and Zhu et al. (89.4%).<sup>3,10</sup> However, the proportion of patients with fractures related to RTA was much higher (24.7%) than shown in the study by Court-Brown et al. (1.4%) and Zhu et al. (3.1%).<sup>3,10</sup> The higher incidence of RTA related fractures in elderly could be associated with higher rates of road traffic crashes mainly related to driving and driver's behavior, mechanical condition of vehicles involved and poorly designed and risk-filled roads in Nepal.<sup>12,13</sup> There is an overall high incidence of road traffic accidents in Nepal with 29.6 road traffic accidents per 100,000 population.<sup>13</sup> Moreover, older adults are more vulnerable road user group with high mortality and morbidity in road accidents.<sup>14</sup> Our study showed higher incidence of open/compound



fractures (4.1%) compared to the findings in the studies by Court-Brown et al. (1.2%) and Zhu et al. (3.1%). Increased incidence of high velocity injury (RTA related injuries and fall from height) among elderly patients with fracture in our study favors this finding.

The incidence of peri-trochanteric fracture, proximal humerus fracture and fractures of hand was increasing with age ( $p < 0.05$ ). This is similar to the findings in other studies which have shown increasing incidence of fragility fractures with age.<sup>3,10,11</sup> However incidence of other fragility fractures e.g. spine and distal radius, though have a positive correlation with age, they are not statistically significant. Comparing the individual fracture incidence in the study done by Court-Brown et al. the incidence in our study is very low.<sup>3</sup> This discrepancy in the incidence of fractures in elderly could be because of severe under reporting of elderly fractures in our set up. In a recent study done in western region of Nepal, a notable proportion of elderly participants (30%) did not utilize health services despite having a health problem.<sup>15</sup> Similarly, in a study done in far western region of Nepal, more than one-third of participants had not visited a health facility in the prior 12 months and nine in 10 participants did not know about the government's free health service for older adults.<sup>16</sup> Another notable fact was health care utilization among elderly was concentrated only among richer individuals which could have restricted financially weak elderly population with fractures from getting hospital care leading to an overall lesser incidence of fracture.<sup>16</sup>

There was a weak negative correlation of patient's age with hospital stay, which means, patients in higher age groups were discharged earlier compared to patients in lesser age group. In our study, patients in lesser age groups had higher incidence of injuries related to high velocity, compound fractures and fractures of spine. These injuries require relatively longer hospital stay compared to other types of injury. This explains why patients in lesser age groups tend to stay relatively longer in the hospital.

This study, being a single centered study, the epidemiological findings may not be generalizable to the whole country population. Furthermore, this study involved only admitted patients. The patients who were discharged or referred from the emergency department/ out-patient department were not included which may have produced selection bias in the results obtained. Retrospective nature of this study is also one of its limitations.

## CONCLUSION

There is female predominance in fractures in elderly with peritrochantric fracture being the most common fracture, and low-energy injury being the most prevalent injury mechanism. A lower fracture incidence among elderly compared to other studies may indicate under reporting of fractures among elderly in Nepal. Higher incidence of RTA and compound fractures among elderly are serious public health concerns highlighting the importance of primary preventive measures for reducing the occurrence of higher velocity trauma and compound fractures among elderly population in Nepal.

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