

Clavicle Fractures: Epidemiology, Classification and Treatment of 1024 Fractures: An Observational Study

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Abstract: *Background: The aim of this observational study was to describe the epidemiology, classification and treatment of clavicle fractures in the the population of Jammu and Kashmir. Methods: Data were retrieved on all clavicle fractures sustained by patients ≥ 15 years of age in 2017–2018 (n = 1028) with regards to date of injury, cause of injury, fracture classification and treatment. Results: Sixty-eight per cent of the clavicle fractures occurred in males. The largest subgroup was males aged 15–24 years, representing 21% of clavicle fractures. At the ages of 65 years and above, females sustained more clavicle fractures than males. Same-level falls and bicycle accidents were the most common injury mechanisms. Displaced midshaft fractures constituted 43% of all fractures and were the most frequently operated fractures. Five percent of the patients underwent operative treatment within 30 days of the injury, where plate fixation was the choice of treatment in 94% of fractures. Conclusion: The largest patient group was young males. Displaced midshaft fractures were the most common type of clavicle fracture as well as the most frequently operated type of fracture.*

Keywords: Clavicle fracture, Epidemiology, Classification, Treatment

1. Background

Fractures of the clavicle, which primarily occur in young males, constitute 2.6–4% of all fractures in adults. A male dominance of approximately 70% has been reported. The most frequent injury mechanism is a direct fall on the shoulder. Fractures are often sustained during sports activities or traffic accidents. The majority (69–82%) of fractures occur in the midshaft of the clavicle, followed by 12–26% in the lateral part and 2–6% in the medial part. This can be anatomically explained by the fact that the medial and lateral parts of the clavicle are firmly secured by strong ligaments and muscles, whereas the middle part of the clavicle lacks any strong attachments and thus is more vulnerable to trauma. The muscle attachments often cause a dislocation of the major fragments in clavicle fractures and a shortening of the clavicle, particularly in midshaft fractures. Traditionally, clavicle fractures have been treated almost exclusively non-operatively, regardless of the type of fracture. Studies in the 1960s described good functional results for non-operatively treated midshaft clavicle fractures and a lower nonunion rate compared to fractures treated with primary open reduction. In contrast, several more recent studies have reported opposite results with newer methods of fracture fixation, which may have contributed to the 705% increase in operative treatment of clavicle fractures. Optimal treatment of clavicle fractures however remains a debated subject. Simple slings, collar 'n' cuffs and figure-of-eight-bandages are commonly used to immobilise the fracture during the first weeks in non-operatively treated fractures, which often include medial fractures, most lateral fractures and midshaft fractures without displacement. The most commonly used operative method today is open reduction and internal plate fixation; a smaller number of fractures are treated with intramedullary nails, pins or wires. Because the treatment of clavicle fractures is a debated question treatment can vary between different departments, with regards both to which fractures are operated and operative method chosen. The largest study populations in epidemiological studies are also at least 20 years old. Much has happened in the area of treatment of clavicle fractures

since then, especially with the rate of operative treatment having increased substantially even with an absence of studies showing compelling evidence to support this. An updated study on the current epidemiology, classification and treatment of clavicle fractures in a more generalized setting would hopefully create a framework for contextual aid for future analysis of the best treatment for clavicle fractures. The aim of this study was therefore to describe the modern epidemiology, classification and treatment of clavicle fractures with a secondary aim of assessing the presence of polytrauma in patients with clavicle fractures.

2. Methods

Data collection and study population started in 2017, information about fractures of the extremities, pelvis and spine. a recent study showed that the incidence of clavicle fractures in jammu and kashmir increased from 35.6 per 100,000 person-years in 2001 to 59.3 per 100,000 person-years in 2018. Clavicle fractures have been registered since April 2017. Selection criteria were all registered clavicle fractures sustained in 2017–2019 and patients had to be at least 15 years of age. No additional exclusion criteria were applied. Medical records and radiographs were also reviewed for the presence of polytrauma in a subset local population comprising all clavicle fractures that were treated. This subpopulation was very similar to the overall population with regards to age, sex and fracture type distribution and is as such representative of the overall study population.

3. Variables

Injury mechanism

Four main categories were constructed for injury mechanism – falls, transport accidents, non-traumatic fractures and others. Falls were further sub-categorised into falls on the same level, falls from a level and unspecified falls. Transport accidents were sub-categorised into bicycle accidents, motorcycle accidents and other transport

accidents. Pathological fractures, spontaneous fractures and stress fractures were grouped together and labeled non-traumatic fractures. The other category included patients who had sustained their clavicle fractures for example from having been pushed to the ground or having suffered a direct impact from a person or object. Many sporting injuries sort into this category. Examples of high-energy injuries are traffic accidents, falls from heights and work place accidents with crushing injuries. Low-energy injuries are exemplified as falls on the same level and similar traumas.

Fracture classification

Clavicle fractures were classified according to Robinson's classification system.

Primary treatment

Operative treatment methods were divided into fixation with anatomical plates, standard plates, hook plates, and other methods. For the non-operatively treated patients no information was provided on the type of sling received for short-term immobilisation or on the application of physiotherapy. Operative treatment was divided into an acute stage and an early stage. Acute stage operations are defined as such when they are registered as the first type of treatment for a particular fracture. Early operations are defined as operations where nonoperative treatment was the first registered choice of treatment but was abandoned early on for secondary operative treatment, typically after an X-ray follow-up 7–10 days after the injury shows a worsened fracture position. An upper cut-off value of 30 days was applied to filter out seemingly faulty registrations. Fractures being treated operatively after more than 30 days post-injury were considered to have been treated non-operatively as the first choice of treatment.

Statistical analysis

Data was summarised for fracture occurrence with groupings of sex, age with subgroupings of both 10-year intervals and groupings of young (15–24 year-olds), mature (25–64 year-olds) and old (over 65 year-olds), time of year and day of the week. Because of the descriptive nature of the study, formal testing of potential differences between subgroups was not made. Calculations of means, first and third quartiles and standard deviations (SD) were made. A minority of the registrations (4%, $n = 87$) were incomplete and lacked one or more types of particular data, such as injury mechanism (1%, $n = 24$), energy level of injury (1%, $n = 33$) or type of treatment (2%, $n = 41$). In these cases data analysis of percentages is based on the total of each completely registered sub-data set.

4. Results

Epidemiology

We found 1024 registered clavicle fractures in 2017–2019; Sixty-eight per cent ($n = 696$) of the clavicle fractures occurred in males and 32% (327) in females, creating a male: female ratio of 2.2:1. Mean age was 48 years (SD 23 years). Mean age was higher in females (mean 59 years, SD 23 years) than in males (mean 43 years, SD 21 years). The fractures occurred more often in younger than in older individuals with 15–24 year-olds representing 21% of the study population. Males in this age group represented 17%

of the total fracture burden. As many as 45% of the females but only 17% of the males were 65 years or older, creating a male: female ratio of 0.8:1 within the age group.

Injury mechanism

The most common cause of injury was either a fall, generally on the same level, or a transport accident. Bicycle accidents were by far the most common cause among the transport accidents, followed by motorcycle accidents. Males and younger patients most commonly sustained their clavicle fractures from transport accidents in comparison to females and older patients who more often sustained their clavicle fractures from a fall. High-energy trauma was reported as the type of injury in 28% of the fractures. Males sustained more high-energy injuries than females: males 35% versus females 17%. The mean age for high energy injuries was also lower (41 years, SD 18 years) than that for low-energy injuries (51 years, SD 24 years). Non-traumatic fractures included pathological fractures ($n = 10$), spontaneous fractures ($n = 5$) and stress fractures ($n = 2$).

Fracture classification

Fifty-two per cent ($n = 1271$) of the clavicle fractures occurred on the left side. Four patients sustained simultaneous bilateral fractures and another 11 sustained multiple clavicle fractures on the same or opposite side at separate times of injury during the 2-year period. Only 0.7% of clavicle fractures were open fractures. The most frequent fracture location was the midshaft of the clavicle. Among the midshaft fractures, 90% had some type of angulation or displacement (2A2, 2B1, 2B2). The most common fractures of all were the midshaft simple displaced or wedge comminuted 2B1 fractures. Medial fractures were uncommon. Ninety per cent of the lateral fractures were extra-articular. Lateral fractures were slightly more often displaced than undisplaced. Displaced midshaft fractures (2B1 and 2B2) were found in 47% of the male patients versus 35% of the female patients. Conversely, lateral fractures were more frequent in females than in males. Medial and lateral fractures were much more common in the higher age groups while younger patients typically sustained midshaft clavicle fractures. The majority of the high-energy injuries resulted in displaced midshaft clavicle fractures.

Primary treatment

Two per cent of all fractures were treated operatively in the acute stage as the first choice of treatment after a median of 5 days (interquartile range 4–10 days). An additional 6% of the fractures were treated operatively after non-operative treatment had been abandoned at an early stage, after a median of 14 days (interquartile range 11–17 days). Males, in comparison with females, were more likely to undergo operative treatment in the acute or early stages: 20% of the males versus 11% of the females. The mean age for operative treatment was 36 years (SD 15 years). The mean age for non-operative treatment was 51 years (SD 23 years). Eighty percent of the operatively treated fractures were midshaft fractures. The most frequently operated fractures were the fully displaced 2B1 and 2B2 midshaft fractures. Together, these two fracture types accounted for 73% of the operatively treated fractures. A fair few of the lateral displaced 3B1 and 3B2 fractures were also treated operatively but since they were not very frequent to begin

with, they accounted for less than 20% of the total number of operated fractures. Few of the midshaft and lateral fractures without full displacement (2A1, 2A2, 3A1, 3A2) and none of the medial fractures were treated operatively. Anatomical plates were by far the most common choice of operative treatment. Hook plates were used mainly for the lateral displaced extra-articular 3B1 fractures while intramedullary nailing was used mainly for the angulated midshaft 2A2 and simple displaced or wedge comminuted 2B1 fractures.

5. Discussion

Main findings

In this observational study of clavicle fractures the largest patient group was males younger than 25 years of age and the most frequent causes of injury were same level falls, bicycle and motorcycle accidents. Displaced midshaft fractures were the most common type of fracture. These fractures, together with extra-articular displaced lateral fractures, were also the most frequently operated fractures. Two per cent of the fractures underwent operative treatment within 30 days of the injury, most commonly with plate fixation

Comparisons with other studies

The mean age of our population of 48 years is actually higher than several other studies of adults, where the mean age ranged from 29 to 34 years. However, the youngest age for inclusion has varied between these studies. As in previous studies, we found that the mean age was highest for fractures occurring in the medial part of the clavicle and lowest for midshaft fractures and that the mean age was higher in females than in males. Inasmuch as clavicle fractures are closely related to physical activities, the difference in frequency is possibly due in large part to an increase in outdoor activities during weekends. Same-level falls have been reported as the most common cause of clavicle fractures not only in this but in previous studies as well. The finding that bicycle accidents were the second most common cause of clavicle fractures is in agreement that bicycle accidents caused 45% of the clavicle fractures in females and 26% in males aged 15 years and above. As in previous studies, left-sided fractures were slightly more common than right-sided fractures whereas bilateral clavicle fractures and open fractures were uncommon. The distribution of fracture types is consistent with previous results Sociodemographic variations such as age or sports involvement among the population as well as injury mechanism should reasonably affect the distribution, suggesting similarities in these areas between our nationally collected data with previous single-department studies. The reported frequency of concomitant orthopaedic injuries has varied somewhat between different studies in the past. In comparison to these studies, we had a large proportion of orthopaedic multiple trauma patients in our local population. The most commonly operated fractures, the displaced midshaft ones, occurred more often in males than in females, which can help explain why the rate of operative treatment was higher in males than in females. Previous studies have shown similar results with regards to epidemiology and classification of clavicle fractures, which might otherwise have helped to explain the discrepancies in treatment. It

therefore seems like treatment decisions are influenced much by local traditions and surgeon preferences, a notion that is supported in the literature. Since convincing evidence to support the selection of one or the other type of treatment (operative versus non-operative treatment, plate fixation versus intramedullary nailing etc.) is missing,

6. Strengths of the study

One of the strengths of the present study is that this observational study is that all data were collected during a recent short period of only 2 years, whereas data collection in earlier studies has often been conducted for many years. This provides an up-to-date overview of epidemiology, classification and treatment of clavicle fractures in recent time. Our minimum age (15 years) was higher than that of many other studies, which in our opinion creates a better platform for analysis of an adult population because of the clinically significant high remodelling capacity of clavicle fractures in children and adolescents.

7. Implications and future research

This study is unique in the sense that it assesses uniformly registered data on epidemiology, classification and treatment of clavicle fractures from a large number of orthopaedic departments. The best treatment for clavicle fractures is a debated subject. In order to know how best to treat them, we must first know what and whom we are treating. This study serves as an up-to-date overview of modern clavicle fractures that will hopefully provide a framework for future research on the treatment of clavicle fractures. Future studies should focus on outcome aspects of the treatment of clavicle fractures in order to obtain better guidelines for treatment.

8. Conclusions

In conclusion, we have described the epidemiology of clavicle fractures that were registered over a 2-year period in the prospective for injury mechanism, fracture classification and treatment. The largest patient group was young males. Displaced midshaft fractures were the most common type of clavicle fracture as well as the most frequently operated type of fracture.

9. Acknowledgements

Not applicable.

10. Consent for publication

Not applicable.

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