Open Access

Data Article

Changing Demographics of Paediatric Femoral Fractures in a District General Hospital: A 9-year Review

Georgina Kakra Wartemberg^{1*}, Faris Ali¹, James Davies¹, Karolina Mazur¹, Parvathi Varma¹, Sade Uwaoma¹, Nirmal Tulwa¹

¹Mid Yorkshire NHS Trust, UK

***Corresponding Author:** Georgina Kakra Wartemberg, Mid Yorkshire NHS Trust, UK;
Email: gkwartemberg@doctors.org.uk

Received Date: 06-04-2021; **Accepted Date:** 23-04-2021; **Published Date:** 30-04-2021

Copyright © 2021 by Wartemberg GK, et al. All rights reserved. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Abstract

Introduction: Paediatric femoral fractures are not uncommon. We noted an anecdotal change in the age of patients that were treated over a number of years. We reviewed all the femoral fracture cases that we have seen since 1st January 2011 to observe if there has been a change in the demographics of paediatric femoral fractures.

Method: We utilised our online theatre system and reviewed every operation list from January 2011 until December 2019, noting all paediatric femoral fracture operations, the age, co-morbidities, and the type of surgery.

Results: 108 cases were identified. All were unilateral cases. 75% were male. The ages ranged from 11 months to 16 years. Children under 5 years of age, sustained injuries from slips and trips, playing in nursery or play areas, and trampoline. There were a good number of fractures caused by family members falling on them. There were 10 suspected non accidental injuries, including one confirmed in this group. Contact sports, skateboarding and cycling dominated in those 6 years and older.

Discussion: There has been a gradual decline in the number of paediatric femoral fracture admissions from 2012. The average age of patients declined from 6.8 years in 2011 to 3.8 years in 2019. Prior to 2014, there were cases of high energy injury from road traffic collisions and motor-cross racing in children aged 12 years and over. After 2014, we did not have any admissions of children over the age of 13 years. This is likely due to Leeds General Infirmary

Wartemberg GK | Volume 2; Issue 1 (2021) | JOSR-2(1)-010 | Data Article

Citation: Wartemberg GK, et al. Changing Demographics of Paediatric Femoral Fractures in a District General Hospital: A 9-year Review. J Ortho Sci Res. 2021;2(1):1-12.

DOI: <http://dx.doi.org/10.46889/JOSR.2021.2105>

gaining its major trauma centre status for our local region and the increased sedentary lifestyle of modern children.

Conclusion: The ages and number of patients presenting with femoral fractures are decreasing in our unit. This is likely due to sedentary lifestyles or due to the effect of having major trauma centre nearby.

Keywords

Paediatric; Femoral Fracture; Accidents; Demographic; Trauma

Introduction

Paediatric femoral fractures are not uncommon. There are multiple causes for such injuries; ranging from low energy falls to high energy injuries sustained during contact sports or motor vehicle collisions [1-3]. Most concerning are non-accidental injury cases that can sometimes be difficult to identify.

In ambulatory children, under the age of 5 years, lower energy injury such as falls from a bed height or play area are common compared to those over 12 years of age, where contact sports and road traffic collisions may dominate [1-5].

Mid Yorkshire National Health Service Trust comprises of three hospitals; Pinderfields General Hospital, Pontefract General Infirmary and Dewsbury District Hospital. The paediatric orthopaedic services from all three hospitals, are concentrated to Pinderfields General Hospital. This hospital sees a number of paediatric traumas; commonly distal radius, humeral and tibial fractures. Most paediatric fractures can be managed non-operatively, with a short period of immobilisation. The remainder are treated surgically. We perform trauma operations on an average of 450 children per year.

With paediatric femoral fractures, we admit and treat all children operatively, whether it is application of a spica cast, fixation with intramedullary flexible or rigid nailing or submuscular plating. This allows for in-patient investigation of suspected non-accidental injury and for a period of traction. For children under 3 years and less that weigh under 12 kilograms, Gallows traction is applied. For older children or those who weigh greater than 12 kilograms, a Thomas splint is applied in the emergency department and then Russell-Hamilton traction once on the ward. The definitive treatment is then performed.

In our trust, we have a dedicated full time paediatric orthopaedic consultant since the year 2000, as well as a part time consultant (since April 2013). We provide paediatric anaesthetic cover

for our dedicated paediatric theatre lists. We are also supported by a major trauma centre, Leeds Teaching Hospital NHS trust which is a mere 12 miles away.

We noted an anecdotal change in the age of patients that were treated over a number of years. We reviewed all the femoral fracture cases that we have seen since 1st January 2011 to observe if there has been a change in the demographics of paediatric femoral fractures.

Method

We utilised our online theatre system, Bluespier and online radiograph system. The Mid Yorkshire NHS trust has documented all orthopaedic admissions and operations on the Bluespier system since January 2011.

We reviewed every operation list from January 2011, citing all paediatric operations. The age of the child at the time of injury, the site of injury, co-morbidities and the mechanism were all noted.

The type of surgery and the timing were documented. The types of surgery included application of spica cast, open reduction internal fixation in the form of plating, intramedullary rigid nailing or flexible nailing, Kirschner wire fixation or external fixation.

The pre-surgical and intraoperative radiographic images were reviewed to confirm the type of fracture. All fractures involving the metaphysis and diaphysis were included. The Arbeitsgemeinschaft für Osteosynthesefragen foundation/Orthopaedic Trauma Association (AO/OTA) fracture classification of this region is 32. If the fracture involved the physis, it was excluded. We distinguished if the fracture was proximal, midshaft or distal by dividing the femoral diaphysis into 3 parts (AO/ OTA qualification of a, b and c). The proximal third was noted as being a proximal fracture (AO/OTA 32a); the middle third being midshaft (AO 32b) and the distal third was documented as a distal fracture (AO 32c). Table 1 summarises our inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Age 0-16 years	Physis involvement
Femoral fracture	Slipped upper femoral epiphysis
Surgical management	Elective osteotomy surgery
	Revision surgery of femoral fixation

Table 1: Explaining the method criteria.

Results

One hundred and eight (108) cases were identified that fulfilled the criteria between 1st January 2011 to 31st December 2019. Eight-one patients were male, making up 75% of the cohort. Twenty-seven were female.

The ages ranged from 11 months to 16 years of age.

97 out of 108 had no co-morbidities. Those that did included three with asthma, two with eczema and the remainder suffered with osteogenesis imperfecta, type 1 diabetes, polyostotic fibrous dysplasia, osteoporosis, retinoblastoma and epilepsy.

Type of Fracture

55 cases had left femoral fractures and 53 were right sided. There were no bilateral fractures at the same presentation.

Eighty-four (84) were spiral or oblique fractures (AO/OTA classification 32A1(b) and 32A2(b)) in the midshaft region (Table 2). 18 were transverse, with 12 of these occurring in the midshaft portion (AO/OTA 32A3(b)), three proximal femur (AO/OTA 32A3(a)) and three were in the distal femur (AO/OTA 32A3(c)). Two were reverse oblique fractures of the proximal femur, one was a distal buckle fracture and two were pathological fractures due to fibrous dysplasia and a simple bone cyst. There was one case of a child sustaining a segmental femoral fracture (AO/OTA 32C2) (Table 2).

Region of Femoral Fracture	Spiral/ oblique fracture (AO 32A1 and 32A2)	Transverse fracture (AO 32A3)	Pathological	Other
Proximal (a)	0	3	2	2
Midshaft (b)	84	12	1	0
Distal (c)	0	3	0	1

Table 2: Fracture description.

Mechanism of Injury

There was a variety of causes for injury (Fig. 1). Most of the children sustained injury whilst playing; such as trampolining or jumping on a bed, playing in a play area/ nursery and contact sports [12-14]. There were many cases of children slipping and falling due to the environment such as a slippery surface or dog lead related injuries [22].

In young children, under 5 years, there were eight cases of injuries sustained when an older relative fell with them. On Fig. 1 and 2, this is shown as family member falls. Slips in the home or outside and falls from less than a foot (adult seated height) were very common in this age group.

Older children (from 6 to 12 years) were more likely to sustain injuries playing contact sports such as football and rugby, and partaking in cycling, riding a scooter and skateboard. There were three cases of children sustaining injuries in road traffic collisions or participating in motor-cross driving and these occurred in children over 13 years of age and one child aged 12 years.

There were ten cases of suspected non-accidental injuries in children aged between 9 months and 4 years. These were investigated thoroughly. Of the ten, one was confirmed to be caused by non-accidental injury.

Figure 1: Causes of injury.

Figure 2: Age group related causes of injury.

Demographics of Presentation

The number of children admitted with femoral fractures have changed over the nine years. There was a steady decline of documented cases from 2012 (Fig. 3).

Even when the number of femoral fracture cases were compared to the total number of paediatric trauma cases per year, the trend was not dissimilar, as shown in Fig. 4.

The total number of paediatric trauma operative cases did increase over time.

There was a distinct change in the ratio of age groups. Children between the age of 0 to 5 years made up 55% of admissions in 2011. By 2018, it was 90% and 2019, it was 79%.

Those aged between 6 and 12 years of age have ranged from 13 to 33% of admissions over the years. After 2014, we did not have any admissions of children over the age of 13 years with femoral fractures.

Wartemberg GK | Volume 2; Issue 1 (2021) | JOSR-2(1)-010 | Data Article

Citation: Wartemberg GK, et al. Changing Demographics of Paediatric Femoral Fractures in a District General Hospital: A 9-year Review. J Ortho Sci Res. 2021;2(1):1-12.

DOI: <http://dx.doi.org/10.46889/JOSR.2021.2105>

In 2011, the average age of children admitted was 6.8 years, ranging from 17months to 16 years. 2012 saw a decrease to 3.7 years (9 months to 13 years). There was an overall steady decline in the average age and the oldest age of children over the years. Graph 6 demonstrates the shift in the ages of children over this period.

Figure 3: Number of children with femoral fractures.

Figure 4: Ratio of femoral fractures to total paediatric trauma per year.

Treatment of Fracture

A vast majority (75%) of fractures were treated in Spica cast. 14 femoral fractures were managed with sub muscular plating, 8 with flexible nailing. The remainder were treated with Kirschner wires, rigid nailing and one case had application of traction and referral to a specialist tertiary centre (Table 3). There were no cases that required application of an external fixator.

From 2011, the ratio of spica applications increased as did sub muscular plating. After 2012, there were no cases that were treated with rigid intramedullary nailing. Figure 7 shows the evolution in the treatment of femoral fractures over the years, from multiple surgical treatments to now utilising spica casting and sub muscular plating exclusively.

Figure 5: Number of children admitted per year by age group.

Figure 6: Age of child with Femoral fracture (months).

Treatment	Age Range	Number treated
Spica casting	11 months- 7 years	81
Submuscular plating	3-15 years	14
Kirschner wires	25 months- 16years	2
Flexible intramedullary nailing	4- 12 years	8
Rigid intramedullary nailing (trochanteric entry)	13- 16 years	2
Other	9 years	1

Table 3: Treatment of fracture.

Figure 7: Surgical management of femoral fractures.

Discussion

Our study has reflected what is seen in most non specialist departments. Studies reviewing paediatric femoral fractures has shown a high preponderance in males after the first year of life [4,5,7]. We found a ratio of male to female patients of 3:1 which is in keeping with the literature [2,3]. Royal Belfast Hospital, a major trauma centre reviewed their paediatric femoral fractures over a 12-month period and demonstrated the same ratio [3].

Over the 9 years, we observed a slow decline in the average age of the patients we operated on, despite an increase in the total number of paediatric operative cases. In 2011 and 2012, there were older children presenting with femoral fractures than previously. There were also more cases of high energy trauma, specifically road traffic collisions. There are many possible reasons for this. It may be due to the fact that Leeds General Infirmary (Leeds Teaching Hospital NHS trust, established 1998) obtained its major trauma status on the 2nd of April 2013. Any cases that fulfilled the major trauma criteria, such as road traffic collisions would have been directed there by ambulance staff, rather than our district general hospital. In our study, all the children over 13 years of age sustained their injuries through road traffic collisions. Had the injury not fulfilled major trauma centre criteria, the children would be admitted to our unit. It would be a useful study to review admissions in Leeds Teaching Hospitals NHS trust to see if the same trend is observed or not.

Secondly, over the years, children have become less active, with hobbies that do not necessarily involve contact sports [8,9]. Activities such as online gaming and television watching are on the rise. Seventy-eight per cent of children do not meet the United Kingdom physical activity guidance of a minimum of 60 minutes of moderate physical activity a day [10]. Lastly, because we do not receive a large number of admissions per annum with femoral fractures, the trend may be inconclusive.

Talbot, et al. reviewed the epidemiology of 1358 paediatric femoral fractures that presented in major trauma centres and trauma units over a three-year period [11]. It showed the peak of incidence of trauma to be two years of age with declining incidence after five years of age. Road traffic collisions played a significant contribution in children aged eleven years and older. This is not dissimilar to what was found in our unit. This paper covered the period of April 2012 to March 2015. If there was a longer study period, there may be evidence to show a change in the age demographic over the years that we have demonstrated.

Falls in play areas and slipping in the home were very common in young children, as were trampoline related fractures. Unsurprisingly, we did find a number of cases of family members falling on children, often associated with carrying the child. Whereas with older children, contact sports and sporting activities dominated.

There were cases of suspected Non-Accidental Injury (NAI) with one confirmed case. Previous systematic reviews have shown the rate of NAI to be 0.5% [11-14]. Non-accidental injury can

often be very difficult to diagnosis, however, having a low threshold for investigating often aids this [14,15]. The morphology and the site of the fracture has been shown to have no correlation to the likelihood of intentional injury [12-15].

In our unit, we admit all paediatric femoral fractures irrespective of mechanism or fracture configuration. This allows us to confirm the history of injury and observe the relationship between the child and guardians. In young children, a safe guarding champion is involved from the time of admission.

Treatment of femoral fractures with spica casting in our unit has markedly increased over the years. This is due to the fact that most of the fractures can be controlled by casting. Secondly, the children presenting were the appropriate age to be comfortably managed in a spica without undue impact on the family [16-18]. Spica casting is considered an acceptable form of management in children up to the age of seven years [4]. Submuscular plating was utilised in cases of length instability and in some older children.

Unsurprisingly, the literature does not support one form of fixation over another for length stable fractures in young children when complications and long-term outcomes are taken into account [20,21]. Whereas with length unstable fractures, submuscular plating and flexible nailing has been shown to be more effective than casting [20,22-26]. In femurs with small canals, plating may be preferable. In older children, there has been a shift towards flexible or rigid intramedullary nailing. This is because of the convenience of early discharge. Days spent in hospital are reduced when early fixation occurs [4,16]. It is also recommended in cases of polytrauma.

Conclusion

Over the nine years of managing paediatric femoral fractures, we have had a gradual decline in admissions. We have noted the average age of children presenting has also decreased rapidly over the years. This could be due to the presence of a local trauma centre as well as reduced participation in physical activity in older children.

References

1. Brousil J, Hunter J. Femoral fractures in children. *Curr Opin Pediatrics*. 2013;25(1):52-7.
2. Bridgman S, Wilson R. Epidemiology of femoral fractures in children in the West Midlands region of England 1991 to 2001. *The J Bone Joint Surg British*. 2004;86(8):1152-7.
3. Cusick L, Thompson NW, Taylor TC, Cowie GH. Paediatric femoral fractures-the royal belfast hospital for sick children experience. *The Ulster Med J*. 2005;74(2):98.
4. Khoriaty AA, Jones C, Gelfer Y, Trompeter A. The management of paediatric diaphyseal femoral fractures: a modern approach. *Strat Traum Limb Recon*. 2016;11(2):87-7.

Wartemberg GK | Volume 2; Issue 1 (2021) | JOSR-2(1)-010 | Data Article

Citation: Wartemberg GK, et al. Changing Demographics of Paediatric Femoral Fractures in a District General Hospital: A 9-year Review. *J Ortho Sci Res*. 2021;2(1):1-12.

DOI: <http://dx.doi.org/10.46889/JOSR.2021.2105>

5. Wright JG, Wang EE, Owen JL, Stephens D, Graham HK, et al. Treatments for paediatric femoral fractures: a randomised trial. *The Lancet*. 2005;365(9465):1153-8.
6. Orthopaedic Trauma Association, AO foundation. *J Orthopaedic Trauma*. Jan 2018;32:1.
7. John R, Sharma S, Raj GN, Singh J. Suppl 2: M4: Current concepts in paediatric femoral shaft fractures. *The Open Orthopaedics J*. 2017;11:353.
8. Winther A, Ahmed LA, Furberg AS, Grimnes G, Jorde R, Nilsen OA, et al. Leisure time computer use and adolescent bone health-findings from the tromsø study, fit futures: a cross-sectional study. *BMJ Open*. 2015;5(6):e006665.
9. Boreham C, Riddoch C. The physical activity, fitness and health of children. *J Sports Sci*. 2010;19:12.
10. Shaun S. Health survey for England 2015 physical activity in children. Health and Social Care Information Centre.
11. Talbot C, Davis N, Majid I, Young M, Bouamra O, Lecky FE, et al. Fractures of the femoral shaft in children. *Bone and Joint*. 2018;100:109-18.
12. Kemp A, Dunstan F, Harrison S, Morris S, Mann M, et al. Patterns of skeletal fractures in child abuse: systematic review. *BMJ*. 2008;337:1518.
13. Scherl S, Miller L, Lively N, Russinoff S, Sullivan C, Tornetta P. Accidental and non-accidental femur fractures in children. *Clin Orthopaedics Related Res*. 2000;376:96-105.
14. Hui C, Joughin E, Goldstein S, Cooper N, Harder J, Kiefer G, et al. Femoral fractures in children younger than three years: the role of non-accidental injury. *J Pediatric Orthopaedics*. 2008;28(3):297-302.
15. Rex C, Kay PR. Features of femoral fractures in non-accidental injury. *J Pediatric Orthopaedics*. 2000;20(3):411-3.
16. Wilson NC, Stott NS. Paediatric femoral fractures: factors influencing length of stay and readmission rate. *Injury*. 2007;38(8):931-6.
17. Cassinelli EH, Young B, Vogt M, Pierce MC, Deeney VF. Spica cast application in the emergency room for select pediatric femur fractures. *J Orthopaedic Trauma*. 2005;19(10):709-16.
18. Lee YH, Lim KB, Gao GX, Mahadev A, Lam KS, Tan SB, Lee EH. Traction and spica casting for closed femoral shaft fractures in children. *J Orthopaedic Surg*. 2007;15(1):37-40.
19. Leu D, Sargent MC, Ain MC, Leet AI, Tis JE, Sponseller PD. Spica casting for pediatric femoral fractures: a prospective, randomized controlled study of single-leg versus double-leg spica casts. *JBJS*. 2012;94(14):1259-64.
20. Khoriaty AA, Jones C, Gelfer Y, Trompeter A. The management of paediatric diaphyseal femoral fractures: a modern approach. *Strat Traum Limb Recon*. 2016;11(2):87-97.
21. Ramo BA, Martus JE, Tareen N, Hooe BS, Snoddy MC, Jo CH. Intramedullary nailing compared with spica casts for isolated femoral fractures in four and five-year-old children. *JBJS*. 2016;98(4):267-75.
22. Say F, Gürlü D, Inkaya E, Yener K, Bülbül M. Which treatment option for paediatric femoral fractures in school-aged children: elastic nail or spica casting? *Euro J Orthopaedic Surg Traumatol*. 2014;24(4):593-8.
23. Kocher MS, Sink EL, Blasler DR, Luhmann SJ, Mehlman CT, Scher DM, et al. Treatment of pediatric diaphyseal femur fractures. *JAAOS-J Am Acad Orthopaedic Surg*. 2009;17(11):718-25.
24. Li Y, Hedequist DJ. Submuscular plating of pediatric femur fracture. *JAAOS-J Am Acad Orthopaedic Surg*. 2012;20(9):596-603.
25. Moroz LA, Launay F, Kocher MS, Newton PO, Frick SL, Sponseller PD, et al. Titanium elastic nailing of fractures of the femur in children: predictors of complications and poor outcome. *J Bone Joint Surg*. 2006;88(10):1361-6.
26. Lohiya R, Bachhal V, Khan U, Kumar D, Vijayvargiya V, Sankhala SS, et al. Flexible intramedullary nailing in paediatric femoral fractures-A report of 73 cases. *J Orthopaedic Surg Res*. 2011;6(1):1-1.