Treatment injuries are rare in children’s femoral fractures
Compensation claims submitted to the Patient Insurance Center in Finland

Sauli Palmu¹,², Reijo Paukku³, Jari Peltonen¹, and Yrjänä Nietosvaara¹,⁴

¹Children’s Hospital, Helsinki University Central Hospital, Helsinki; ²Orton Orthopaedic Hospital, Orton Foundation, Helsinki; ³Orto-Lääkärit, Medical Center, Helsinki; ⁴the Patient Insurance Center, Helsinki, Finland
Correspondence: sauli.palmu@helsinki.fi
Submitted 09-11-26. Accepted 10-07-02

Background and purpose  The current treatment for femoral fractures in children is mostly operative, which contrasts with treatment of other long bone fractures in children. We analyzed treatment injuries in such patients in Finland in order to identify avoidable injuries. Our other aims were to calculate the incidence of these fractures and to describe the treatment method used.

Methods The Patient Insurance Centre (PIC) provides financial compensation of patients who have sustained an injury in connection with medical care. We retrospectively analyzed incidence, treatment methods, and all compensation claims concerning treatment of femoral fractures in children who were 0–16 years of age during the 8-year period 1997–2004.

Results The incidence of childhood femoral fractures in Finland was 0.27 per 1,000 children aged <17 years, and two-thirds of the patients were treated operatively during the study period. 30 compensation claims were submitted to PIC during the 8-year study period. The compensation claims mainly concerned pain, insufficient diagnosis or treatment, extra expenses, permanent disability, or inappropriate behavior of medical personnel. Of the claims, 16 of 30 were granted compensation. Compensation was granted for delay in treatment, unnecessary surgery, and for inappropriate surgical technique. The mean amount of compensation was 2,300 euros. Of the injuries that led to compensation, 11 of 16 were regarded as being avoidable in retrospect.

Interpretation The calculated risk of a treatment injury in childhood femoral fracture treatment in Finland is approximately 2%, and most of these injuries can be avoided with proper treatment.

The reported incidence of femoral fractures in childhood varies between 0.22 and 0.33 per 10³ children (Lyons et al. 1999, Bridgman and Wilson 2004). Femoral fractures represent 1–2% of all fractures in children and adolescents (Landin 1997, Lyons et al. 1999, Hedin 2004). Together with forearm and tibial fractures, they are the most common childhood long-bone injuries (Salem et al. 2006).

For a long time, femoral fractures have been treated by traction and/or casting. More recently, surgery has gained popularity (Yandow et al. 1999, Hedin 2004, Bopst et al. 2007). Hedin (2004) has proposed a treatment protocol for femoral fractures in children whereby operation is the preferred option in children over 3 years of age.

With nonoperative treatment, complications include malunion, nonunion, and skin lesions. In addition to these, operative treatment can lead to nerve injuries, infections, or pain and irritation at the site of incision (Narayanan et al. 2004, Wall et al. 2008).

We have reported treatment injuries in children’s lower leg fractures in an earlier study (Palmu et al. 2009). There have not, however, been any studies on treatment injuries of femoral fractures in children. In this study we explored what kind of treatment injuries occur and we identified avoidable injuries. We also calculated the incidence. In this paper we also describe the method of treatment of femoral fractures in children in Finland.

Patients and methods

The Patient Insurance Center (PIC) in Finland grants compensation to patients who have sustained injuries associated with medical care without having to prove any treatment to be faulty. According to the Finnish Patient Injuries Act, a compensatable treatment injury has occurred if an experienced medical professional would have proceeded in a different manner and thus avoided the injury. The patient information and data concerning compensation claims for femoral fractures in children during the study period came from the reg-
The PIC made the final decision regarding compensation. An independent observer (a consultant pediatric orthopedic surgeon (RP) who was not involved in patient treatment or in handling of claims) retrospectively analyzed all patient claims (n = 30) and decisions concerning treatment during the study period (1997–2004), with re-evaluation of patient treatment files, statements of PIC experts, and decisions about compensation. Age, sex, and type and location of the fracture were recorded. Trauma energy was graded as high (traffic accident, fall from a height > 6 m), moderate (sporting injuries), or low (falling on level ground), and mode of treatment, complications, and permanent sequelae were assessed along with reasons for the claim and for the compensation. Information concerning the amount of compensation for these patients was provided by PIC, and the number of avoidable treatment injuries was estimated.

The annual incidence of femoral fractures in children was calculated using registry data and the method of treatment was analyzed in retrospect using the registers of the National Institute of Health and Welfare.

The statistical analysis was performed using SPSS software version 16.0. 95% confidence interval (CI) for incidence was calculated using the Poisson distribution.

### Results

During the 8-year study period (1997–2004), the PIC received 30 compensation claims concerning femoral fracture treatment in children. The mean age of these patients treated in healthcare centers (n = 6) was 3 (0–11) years, and it was 11 (0–16) years in hospitals of different kinds (n = 24). There were no open fractures, but there were 3 pathological fractures: 2 children had simple bone cysts and 1 had osteogenesis imperfecta. 1 child suffered multiple injuries after a fall from the sixth floor (Table 1).

### Table 1. Characteristics of the 30 claims for compensation submitted to the PIC

| Age | Injury | Fracture | Treatment institution | Primary treatment | Complication | Compensation claim | Compensation, reason | Avoidable |
|-----|--------|----------|-----------------------|-------------------|--------------|-------------------|---------------------|-----------|
| 0.1 | Fall < 1 m | S | HC | T | Delay in diagnosis | No, no effect on outcome | Yes |
| 0.5 | Fall < 1 m | M | HC | None | Delay in diagnosis | No, no effect on outcome | No |
| 0.6 | Fall on level | S | CH | None | Delay in diagnosis | Yes, inadequate clinical examination | Yes |
| 1.2 | Fall on level | S | CH | T + C | Delay in diagnosis | Yes, fracture dislocated due to delay | Yes |
| 1.6 | Fall on level | S | HC | C | Delay in diagnosis | No, no effect on outcome | Yes |
| 1.8 | Fall on level | S | HC | T | SU | Inadequate casting | Yes, inadequate cast padding | Yes |
| 2.0 | Child abuse? | S | CH | T | Pain and suffering | No, satisfactory treatment | No |
| 2.1 | Child abuse? | S | CH | T | SU | Inadequate treatment | No, ulcer not caused by treatment | No |
| 3.2 | Fall > 15 m | M | UH | T | SU | Inadequate treatment | Yes, wrong treatment method | Yes |
| 4.3 | Ice hockey | S | UH | ST | Delay in treatment | No, fracture not visible in radiographs | No |
| 4.5 | Playground | S | CH | T + C | Angular deformity | Yes, angular deformity | No |
| 4.7 | Sledding | M | HC | None | Missed diagnosis | Yes, fracture missed on radiographs | Yes |
| 5.6 | Fall on level | S | UH | FIN | Pain and irritation | No, satisfactory treatment | Yes |
| 5.7 | Child abuse | S | CH | SF | Inf | Infection | Yes, unreasonable infection | No |
| 6.9 | Sledding | S | HC | None | Delay in diagnosis | Yes, no primary radiographs | Yes |
| 7.6 | Downhill skiing | S | CH | FIN | Growth plate injury | No, caused by primary injury | No |
| 8.2 | Fall 4 m | S | CH | ST | Inf | Infection | Yes, unreasonable infection | No |
| 8.3 | Sledding | S | CH | T + FIN | SU | Inadequate treatment | No, satisfactory treatment | No |
| 8.8 | Bicycle | S | UH | FIN | BI | Burn injury | Yes, inadequate use of diathermia | Yes |
| 9.2 | Downhill skiing | P | CH | C | Growth plate injury | No, caused by primary injury | No |
| 10.2 | Ice hockey | S | CH | FIN | No | Inadequate treatment | No, satisfactory treatment | No |
| 10.2 | Soccer | M | UH | SF | No | Inadequate treatment | Yes, improper positioning of screws | Yes |
| 11.9 | Fall on level | M | CH | SF | Inadequate treatment | No, satisfactory treatment | No |
| 14.0 | Soccer | P | CH | None | Inadequate treatment | No, satisfactory treatment | Yes |
| 14.4 | Fall on level | M | UH | SF | Inf | Infection | Yes, unreasonable infection | No |
| 15.4 | Bicycle | S | UH | FIN | JSD | Pain and irritation | Yes, damaging joint surface by RIN | Yes |
| 15.4 | Bicycle | S | CH | RIN | Growth disturbance | Yes, wrong treatment method | Yes |
| 15.4 | Motorcycle | S | UH | FIN | No | Inadequate treatment | Yes, diagnosis of PA was delayed | No |
| 16.8 | Motorcycle | S | DH | RIN | PA | Inadequate treatment | No, pain and suffering | No |

*M*: metaphysis, *P*: physis, *S*: shaft.

Table: Central hospital, *D*: district hospital, *HC*: healthcare center, *UH*: university hospital.

*C*: cast, *FIN*: flexible intramedullary nailing, *RIN*: rigid intramedullary nailing, *SF*: screw fixation, *ST*: skeletal traction, *T*: traction.

*BI*: burn injury (caused by inadequate use of diathermia), *Inf*: infection, *JSD*: joint surface damage (caused by intramedullary nailing), *PA*: pseudo-arthrosis, *SU*: skin ulcer.
Primary treatment (16 operative, 6 skin traction, 3 casting, and 5 with no initial treatment) was given in healthcare centers (6 patients), a district hospital (1 patient), central hospitals (15 patients), and university hospitals (8 patients). The operative treatment of 16 of the 30 patients consisted of intramedullary nailing in 8 children (4 elastic and 4 rigid nails), skeletal traction in 4, screw fixation in 3, and plate osteosynthesis in 1 child. The nonoperative treatment consisted of skin traction continued by circular casting in 6 children, hip-spica casting in 2, and circular casing only in 1 child. Of the 5 children with no initial treatment, 4 were later treated by casting. The mean age of children treated nonoperatively was 4 years and it was 11 years in children treated operatively. Complications occurred in 11 of the 30 children (Table 1).

The claims for compensation were based on pain (n = 20), insufficient diagnosis or treatment (n = 17), extra treatment expenses (n = 9), permanent disability (n = 7), and inappropriate behavior of medical personnel (n = 2). In 17 cases, there were claims for more than 1 issue. Of the 30 claims for compensation, 16 were granted. Compensation was granted for 13 treatment injuries and 3 infections. The treatment injuries involved delay in treatment of 3 children, unnecessary operation in 2, inappropriate surgical technique in 2, and other reasons in 5 children. The delay occurred in diagnosis in 2 children and in detecting nonunion in 1 child. The surgical techniques considered to be inappropriate in retrospect were plate fixation of a subtrochanteric fracture and inadequate intramedullary nailing leading to joint surface damage. All 3 infection injuries were related to operative treatment and they were considered to be unreasonably serious.

The PIC granted an overall sum of approximately 42,000 euros as compensation to the patients. The average compensation granted was 2,300 euros. Compensation was granted for permanent sequelae (14,200 euros), for pain (13,700 euros), for cosmetic reasons (9,600 euros), and for other reasons (4,200 euros). The PIC estimated that approximately 32,000 euros would still be paid to the patients.

Of the 16 injuries that were given compensation, in retrospect we regarded 11 of them as being avoidable. The injuries we regarded as being unavoidable were a nonunion in a child with a broken intramedullary nail, 3 postoperative infections, and a malunion after casting. In the latter child, we did not agree with the PIC compensation for an angular deformity in a 4-year-old child which would most likely have remodeled.

During the study period, the mean total population of Finland was 5.2 × 10^6 inhabitants; of these, 1.1 × 10^6 were children. The calculated annual incidence of childhood femoral fractures was 0.27 per 10^3 (CI: 0.10–0.29). The treatment method was operative in two-thirds of cases during the study period (Table 2). The calculated risk of sustaining a patient injury in treatment of childhood femoral fractures in Finland during this period was 2.2%.

### Discussion

Femoral fractures constitute 2% of all fractures in children. According to Lyons et al. (1999), the incidence is 0.32 per 1,000 children. Despite its rarity, femoral fracture is the commonest children’s trauma to end up with hospitalization (Loder et al. 2006). The national incidence in Finland (0.27 per 1,000) based on register data is in accordance with earlier reports. We believe that this figure is reliable since, with few exceptions, these children are hospitalized.

The number of complications in all children’s femoral fractures treated in Finland that are reported here is most likely an underestimate, since we only evaluated the ones that led to filing of a compensation claim. Most of the treatment injuries were regarded in retrospect to be avoidable with more careful clinical practice: careful clinical examination and follow-up including skin examination and radiography. The reasons for unavoidable injuries were mostly infection-related. In previous studies operative treatment has led to minor complications such as pain or superficial infections. More severe complications include deep infection, malunion, and neurological deficits (Narayanan et al. 2004, Wall et al. 2008). Narayanan et al. (2004) also suggest that the complications are potentially avoidable. In our series, one-third of the patients suffered from complications. These were similar to those reported earlier.

The average amount of compensation was 2,300 euros. The most common reasons for compensation claims were excessive pain and/or insufficient diagnosis or treatment. These are matters that could be avoided with normal clinical practice. Although the amount of compensation was generally low, this extra cost and unnecessary suffering of the children could be avoided.

The treatment method for femoral fractures in children varies. According to the recommendation of Buckley (1997), children under the age of 6 should be treated with spica casting, those from the age of 10 like adult patients, and children from 6 to 10 with either casting or by operative means. Hedin (2004) on the other hand, recommended traction and

### Table 2. The method of treatment of 1,389 childhood femoral fractures in Finland during 1997–2004 according to national registry data

| Method                               | n  |
|--------------------------------------|----|
| Cast immobilization in situ          | 142|
| Manipulation + cast immobilization   | 229|
| Skin traction                        | 29 |
| Internal fixation                    | 762|
| intramedullary nail                  | 616|
| screw fixation                       | 87 |
| plate osteosynthesis                 | 59 |
| Skeletal traction                    | 143|
| External fixation                    | 50 |
| Unspecified operative treatment      | 0  |
| Reoperation                          | 14 |
spica casting only for children under the age of 3, with others being treated operatively. According to Finnish national register data, two-thirds of children with femoral fractures were treated operatively. The primary treatment method in the children described here was nonoperative in 17 patients and operative in 13 patients. There was a difference in the mean ages of these patient groups: 4 and 11 years, respectively, which is in line with recommendations. The parents of the patients who were treated operatively filed less claims for compensation than those treated nonoperatively. This may mean that there was more satisfaction with treatment.

In conclusion, most femoral fractures in children are treated operatively in Finland. Most of the treatment injuries can be avoided.

SP: study design, preparation of manuscript, data analysis, and statistical analysis. RP: data collection and analysis. JP and YN: study design and preparation of manuscript.

Bopst L, Reinberg O, Lutz N. Femur fracture in preschool children. Experience with flexible intramedullary nailing in 72 children. J Pediatr Orthop 2007; 27 (3): 299-303.

Bridgman S, Wilson R. Epidemiology of femoral fractures in children in the West Midlands region of England 1991 to 2001. J Bone Joint Surg (Br) 2004; 86:1152-7.

Buckley S. Current trends in the treatment of femoral shaft fractures in children and adolescents. Clin Orthop 1997; (338): 60-73.

Hedin H. Surgical treatment of femoral fractures in children. Comparison between external fixation and elastic intramedullary nails: A review. Acta Orthop Scand 2004; 75 (3): 231-40.

Landin L A. Epidemiology of children’s fractures. J Pediatr Orthop B 1997; 6: 79-83.

Loder R T, O’Donnell P W, Feinberg J R. Epidemiology and mechanisms of femur fractures in children. J Pediatr Orthop 2006; 26 (5): 561-6.

Lyons R A, Delahunty A M, Kraus D, Heaven M, McCabe M, Allen H, Nash P. Children’s fractures: a population based study. Injury Prevention 1999; 5: 129-32.

Narayanan U G, Hyman J E, Wainwright A M, Rang M, Alman B A. Complications of elastic stable intramedullary nail fixation of pediatric femoral fractures, and how to avoid them. J Pediatr Orthop 2004; 24 (4): 363-9.

Palnu S, Pauku R, Mayranpia M K, Peltonen J, Nietosvaara Y. Injuries as a result of treatment of tibial fractures in children. Acta Orthop 2009; 80 (1): 78-82.

Salem K H, Lindemann I, Keppler P. Flexible intramedullary nailing in pediatric lower limb fractures. J Pediatr Orthop 2006; 26 (4): 505-9.

Wall E J, Jain V, Vora V, Mehlman C T, Crawford A H. Complications of titanium and stainless steel elastic nail fixation of pediatric femoral fractures. J Bone Joint Surg (Am) 2008; 90: 1305-13.

Yandow S, Archibeck M J, Stevens P M, Shultz R. Femoral-shaft fractures in children: A comparison of immediate casting and traction. J Pediatr Orthop 1999; 19 (1): 55-9.