COMPARISON OF HIP FRACTURE TREATMENT IN FINLAND, GREAT BRITAIN AND SWEDEN WITH SPECIAL REFERENCE TO EVALUATION METHODS

TERO HEIKKINEN
Faculty of Medicine, Division of Orthopaedic and Trauma Surgery, Department of Surgery, University of Oulu

OULU 2005
TERO HEIKKINEN

COMPARISON OF HIP FRACTURE TREATMENT IN FINLAND, GREAT BRITAIN AND SWEDEN WITH SPECIAL REFERENCE TO EVALUATION METHODS

Academic Dissertation to be presented with the assent of the Faculty of Medicine, University of Oulu, for public discussion in the Auditorium 2 of Oulu University Hospital, on December 9th, 2005, at 12 noon

OULUN YLIOPISTO, OULU 2005
Heikkinen, Tero, Comparison of hip fracture treatment in Finland, Great Britain and Sweden with special reference to evaluation methods
Faculty of Medicine, Division of Orthopaedic and Trauma Surgery, Department of Surgery, University of Oulu, P.O.Box 5000, FIN-90014 University of Oulu, Finland
2005
Oulu, Finland

Abstract

The treatment of hip fractures in the elderly has been under debate for decades. There is a lack of standardisation of treatment and rehabilitation and also concerning the measurements and follow-up times in studies on treatment.

Two patient series with cervical hip fractures treated with Austin Moore hemiarthroplasty in Finland and hook pin osteosynthesis in Sweden were compared using matched-pair analysis in view of different age groups. Hip fracture treatments in six hospitals in Finland and one in Great Britain were surveyed. The adequacy of a short four-month follow-up was studied by comparing outcomes at four months and one year. Standardised Audit of Hip Fractures in Europe data collection sets were tested and used in three studies.

Osteosynthesis resulted in lower one-year mortality but a higher reoperation rate in patients aged 55–75 years and was associated with a lesser need for walking aids, less pain and lower four-month mortality in patients aged 76–80 years. There were some differences in the patient characteristics and the methods of treatment between Great Britain and Finland. In Great Britain, more patients returned to their own homes, but one-year mortality after trochanteric fractures was higher. Hip fracture treatments and outcomes were quite similar between the six Finnish hospitals. There was a slight difference in adjusted postoperative mobility and mortality in two hospitals compared to the others. Six of the ten functional domains and residential status remained unchanged, while walking ability and four functional domains improved between four months and one year. The standardised data set was a practical and reliable way to acquire a great variety of information on hip fracture patients, treatments and outcomes.

Hook pin osteosynthesis can be recommended for patients with cervical hip fractures younger than 80 years, whereas older patients can also be safely treated with Austin Moore hemiarthroplasty. The characteristics and outcomes of hip fracture patients were rather similar between Finland and Great Britain and between the different Finnish hospitals irrespective of the variety of methods used in treatment. Standardised Audit for Hip Fractures in Europe is a reliable data collection set and suitable as a basis of hip fracture surveys, audits and registers. Four-month follow-up is justified as the shortest feasible alternative in studies on rehabilitation and residential status after hip fractures.

Keywords: functional outcome, hemiarthroplasty, hip fracture, osteosynthesis
To my wife
Acknowledgements

This study was carried out at the Department of Surgery, Oulu University Hospital, during the years 1997-2005.

I owe my warm thanks to my supervisor, Professor Pekka Jalovaara, M.D., Ph.D., in whose research group this work was carried out. He provided me with valuable ideas, material, financial support, guidance, criticism and exhortation to perform the studies.

I thank my co-workers Professor Karl-Göran Thorngren, M.D., Ph.D., Professor Hans Wingstrand, M.D., Ph.D., Aimo Alavaikko, M.D., Ph.D., Mikael von und zu Fraunberg, M.D., Ph.D., Juha Partanen, M.D., Ph.D., Martyn Parker, M.D., FRCS(Ed), Reeta Willig, M.D., Antero Hänninen, M.D., Kari Koskinen, M.D., Pertti Mannismäki, M.D., and Jukka Ristiniemi, M.D.,

I would like to thank Docent Hannu Kuokkanen, M.D., Ph.D., and Docent Peter Lüthje, M.D., Ph.D., for reviewing the present manuscript and for their useful comments and constructive criticism.

I wish to thank Hannu Vähänikkilä, M.Sc., and Mikko Simonaho, M.Sc., for their assistance with statistical problems.

Sincere thanks go to Eila Haapakoski for practical assistance and encouragement during this study.

I also thank Sirkka-Liisa Leinonen, Lic.Phil., for the language revision of the manuscript.

I thank my friends and colleagues Tuukka Korhonen, M.D., and Timo Kauppinen, M.D., for their peculiar spurring and criticism during all these years. This is the result.

I owe warmest thanks to my parents Elvi and Pentti Heikkinen who have gave me persistence and common sense which both are essential in scientific work and medical practice. I also thank my brothers Ari Heikkinen and Kari-Pekka Heikkinen and his family, and my parents-in-law Sinikka and Veikko Haverinen, and brother-in-law Antti Haverinen for their support and interest to this work.

Finally, I wish to give my warmest thanks to my wife Hanna, who has loved and encouraged me through all these years together.

This research was financially supported by Finnish Medical Association Duodecim.

Oulu, October 2005

Tero Heikkinen
Abbreviations

ADL  Activities of daily living
ASA  American Society of Anaesthesiologists classification
BADL  Basic activities of daily living
BMI  Body mass index
CI  Confidence interval
HA  Hemiarthroplasty
IADL  Instrumental activities of daily living
LIH OS  Lars Ingvar Hansson osteosynthesis
LPADL  Lower extremity physical activities of daily living
NS  Non-significant
OS  Osteosynthesis
PADL  Physical activities of daily living
RR  Relative risk
SAHFE  Standardised Audit for Hip Fractures in Europe
SHS  Sliding hip screw
SPMSQ  Short portable mental status questionnaire
THA  Total hip arthroplasty
UPADL  Upper extremity physical activities of daily living
List of original articles

This thesis is based on the following original articles:


Contents

Abstract
Acknowledgements
Abbreviations
List of original articles
1 Introduction .................................................................15
2 Review of the literature ......................................................17
   2.1 Anatomy and classification of hip fractures .........................17
   2.2 Epidemiology ..........................................................19
   2.3 Treatment of cervical hip fractures ....................................20
   2.4 Evaluation of hip fracture treatment and outcomes ..................21
      2.4.1 Details of injury and patients’ general health ......................21
      2.4.2 Detailed information on treatment ..................................22
      2.4.2.1 Preoperative delay ..................................................22
      2.4.2.2 Anaesthesia .........................................................22
      2.4.2.3 Antibiotic and thromboembolic prophylaxis ....................22
      2.4.3 General complications .............................................22
      2.4.4 Surgical complications and reoperations .........................23
      2.4.5 Functional outcome ................................................24
      2.4.5.1 Walking ability .....................................................24
      2.4.5.2 Walking aids .......................................................25
      2.4.5.3 Residential status ...............................................25
      2.4.5.4 Activities of daily living ..........................................26
      2.4.6 Pain .................................................................27
      2.4.7 Mortality ............................................................27
      2.4.8 Length of follow-up ...............................................28
      2.4.9 Comparisons between hospitals ....................................28
      2.4.10 Comparisons between different countries .........................29
      2.4.11 Standardised audits ..............................................30
3 Aims ...........................................................................31
4 Patients and methods ......................................................32
1 Introduction

Hip fracture is a common and important cause of loss of function and mortality in the elderly population (Keene et al. 1993). In Finland, the number of hip fractures in people aged 50 or over rose from 1857 in 1970 to 7122 in 1997 (Kannus et al. 1999). It is not only that patients suffer from hip fractures, but they also cause remarkable costs to society. The average one-year cost of hip fracture was 14,410 euros in Finland in 2003 (Nurmi et al. 2003), and caring for hip fracture patients costs nearly six billion US dollars per year in USA (Hannan et al. 2001). The costs of treating a hip fracture patient are about threefold compared to the caring for a patient without a fracture (Haentjens et al. 2001).

The main objective of the treatment of hip fracture is to help the patient regain his/her pre-fracture level of functional ability. No consensus has been achieved in the treatment of cervical hip fractures as to whether one of the two main treatment modalities, hemiarthroplasty or osteosynthesis, should be considered the primary mode of treatment (Lu-Yao et al. 1994).

Treatments and outcomes vary between different countries and between hospitals within one country (Jalovaara et al. 1992, Mozes et al. 1999). Comparison of treatments and outcomes between medical centres treating hip fractures can yield information for the development of treatment and serve as a quality assessment of care for the participating hospitals (Todd et al. 1995).

Studies of hip fracture treatment and rehabilitation, however, lack standardisation of the measurements used to report results (Treml & Kroker 2000). The European Union supported project titled “Standardised Audit of Hip Fractures in Europe (SAHFE)” developed a data set for hip fracture studies (Parker et al. 1998). It was developed to promote Europe-wide comparisons of demographic features, surgical techniques and rehabilitation methods, to determine the practicalities of collecting and disseminating this information on an Europe-wide basis, to evaluate the effectiveness of and differences in hip fracture care throughout Europe and to facilitate the dissemination of the best practices of hip fracture surgery and rehabilitation throughout Europe.

The follow-up periods used in studies of hip fracture treatment also lack standardisation, and the adequate follow-up time is not known. In previous studies,
follow-up times have varied from a few months up to ten years, although a short follow-up would be more effective (Borgquist et al. 1990, Berglund-Rödén et al. 1994).

This thesis focuses on the hip fracture treatment and outcomes in different countries and hospitals, with a special emphasis on the methods of evaluation. The two main modalities of treatment for cervical hip fractures, hemiarthroplasty and osteosynthesis, were also compared in view of different age groups.
2 Review of the literature

This thesis focuses on hip fractures in patients aged 50 years and over. In this age group, hip fracture is generally caused by low-energy trauma associated with falling from standing height or lower. In younger patients, hip fractures are usually caused by high-energy trauma, such as traffic accidents and falls from height (Robinson et al. 1995, Hwang et al. 2001, Verettas et al. 2002). Therefore, hip fractures in the elderly are considered as an entity.

2.1 Anatomy and classification of hip fractures

Hip fractures are first classified according to their anatomical location as intra- and extracapsular fractures, depending on whether the fracture is inside or outside the capsule of the hip joint. Intracapsular fractures include subcapital and transcervical fractures. Basicervical, pertrochanteric and subtrochanteric fractures are classified as extracapsular fractures. Cervical fractures are also called femoral neck fractures and pertrochanteric fractures trochanteric. Fractures at the level of the lesser trochanter or below it are called subtrochanteric fractures. Depending on the classification used, it can locate up to 5-7.5 cm below the lesser trochanter (Guyton 1998).

Fig. 1. Classification of hip fractures.
Several classifications of cervical hip fractures exist. The Garden (1961) classification divides fractures into four categories based on the degree of displacement of the bony trabeculae on an anteroposterior roentgenogram. Garden I and II fractures are undisplaced and Garden III and IV are displaced cervical fractures. This classification into displaced or undisplaced fractures has been found to be sufficient for clinical use (Eliasson et al. 1988).

The Pauwels (1935) classification of cervical fractures is based on the mechanical stability of the fracture. The Pauwels and AO classifications (Müller et al. 1990) have little clinical relevance (Parker 1997), and the Garden classification has been found to be more reliable than the Pauwels classification for the prognosis of recovery (Nieminen & Satokari 1975).

The definition of basicervical fracture is controversial. Parker (1997) defined it as a hip fracture in which the fracture line runs along the line of the anterior attachment of the capsule. Blair et al. (1994) specified it as a proximal femoral fracture through the base of the femoral neck at its junction with the intertrochanteric region. Basicervical fracture is a very uncommon entity and should be classified and treated as a trochanteric fracture (Saarenpää et al. 2002).

There are also several classifications of trochanteric fractures. Evans (1949) classified these fractures as stable and unstable. Jensen modified Evans’ classification, and this modification is most useful for clinicians (Jensen & Michaelsen 1975). The AO classification (Müller et al. 1990) and the Boyd and Griffin (1949) classifications are also in use.
2.2 Epidemiology

In Finland, the number of hip fractures in people aged 50 or over rose from 1857 in 1970 to 7122 in 1997 (Kannus et al. 1999). The corresponding fracture incidence (per 100,000 people) increased from 163 to 438. The age-adjusted incidence of hip fractures also increased between 1970 and 1997: in women from 292 to 467, and in men from 112 to 233. However, the reliability of these figures has been questioned. First, Huusko et al. (1999) found that, in Central Finland, hip fracture incidence had not risen between 1982 and 1993. They also found an unexpectedly large number of false or multiple data in the hospital discharge register. Later, Sund (2005) investigated the Finnish Health Care Register covering whole Finland and found that the number of hip fractures per year was stable, around 5500 patients per year, incidence being around 320 per 100,000, and age-adjusted incidence 415 in women and 200 in men during 1998-2002.

In Norway the age-adjusted hip fracture rates were 105 for women and 36 for men in 1978-79, 124.3 and 45 in 1988-89, and 118 and 44 in 1996-97, respectively (Lofthus et al. 2001). The lifetime risk of hip fracture varies between 1% in Turkey to 29% in Sweden (Kanis et al. 2002).

In developing countries the age-adjusted incidence of hip fracture is markedly lower than in developed countries. It has been argued that the discrepancy might be explained by the different degrees of urbanisation. This implicates the promotion of physical activity as a public health measure to prevent hip fracture (Sembo et al. 1988, Pratt & Holloway 2001, Phadungkiat et al. 2002). Urbanisation and the increasingly western lifestyle in developing countries have raised the incidence of hip fractures towards the levels observed in developed countries (Huang et al. 2000; Koh et al. 2001, Lau et al. 2001). Of the developed countries, Sweden had a higher incidence of hip fractures among urban compared to rural population in the 1980’s (Sembo et al. 1988), but no similar trend was seen in Finland (Lüthje et al. 1995a, Lüthje et al. 1995b). Hip fracture incidence is higher among white than black people (Cummings et al. 1989).

The number of patients with hip fractures has been rising annually for the last few decades as a result of the combination of the increasing elderly population and the continued increase in age-specific incidence (Boyce & Vessey 1985, Parkkari et al. 1994). According to forecasts, the number of hip fractures will increase threefold in Finland between 1997 and 2030 (Kannus et al. 1999) and sevenfold in Belgium between 2001 and 2050 (Reginster et al. 2001).

There are also findings suggesting that the age-specific incidence of hip fractures in developed countries, which has been increasing, is now flattening out or even becoming static. However, the total number of hip fractures will continue to increase due to the ageing of the population (Huusko et al. 1999, Kannus et al. 1999, Lau et al. 1999, Rogmark et al. 1999, Balasegaram et al. 2001).
The treatment of cervical hip fractures has been under debate for decades (Speed 1935, Parker & Pryor 2000). The two main methods used in treatment are reduction of the fracture using internal fixation, i.e. osteosynthesis (OS), and hip replacement arthroplasty.

The cervical hip fracture is probably the fracture for which there exists the largest number of OS methods (Strömqvist et al. 1983). Lars Ingvar Hansson (1982) developed hook pins for the fixation of slipped capital femoral epiphysis in children. The OS technique for cervical hip fracture with two hook pins was developed in the late 1970s (Strömqvist et al. 1983). Prospective comparisons between different types of OS have shown no remarkable differences in outcomes (Zukor et al. 1985, Clark et al. 1990, Sernbo et al. 1990, Kuokkanen et al. 1991, Herngren et al. 1992, Jarolem et al. 1993, Elmerson et al. 1995, Alho et al. 1998, Lagerby et al. 1998, Lykke et al. 2003). Thus, the reviewers of the Cochrane Database could not make any definite conclusions concerning the choice of implant for the internal fixation of intracapsular fracture based on the available evidence from randomised trials (Parker 2003b).

Arthroplasty of the hip can be performed either as hemiarthroplasty (HA) by replacing only the femoral part of the hip joint using a semi-endoprosthesis or as total hip arthroplasty (THA), where the acetabulum is also replaced. There are numerous different types of HAs. The main differences between the implants lie in the design of the stem, depending on whether the stem is fixed in place with or without cement, and whether a second articulating joint is included within the prosthesis (bipolar prosthesis). Further, stems can have different surface coatings to stabilise the prosthesis to the femur by bone growth into the stem, and different coatings for heads are also available (Parker 2003a).

In 1940, Austin Moore inserted the first vitallium prosthesis to replace the proximal femur, and this was developed into a straight-stemmed prosthesis in 1950 (Moore 1957, Strömqvist et al. 1987, Strömqvist et al. 1992). The prosthesis was later modified by changing the neck angle, and the stem was fenestrated. The Austin Moore prosthesis is usually inserted without bone cement, but cement can optionally be used. The Austin Moore and Thompson prostheses are the best known HAs and remain the two most frequently used HA prostheses over 40 years after their introduction. However, newer prostheses have been introduced with modular design, i.e. size of the stem and the head can be chosen by the surgeon to best fit the patient (Parker 2003a). Anyhow, according to a large review of different hip arthroplasties in the Cochrane Database of Systematic Reviews, cementing the prosthesis in place seems to reduce pain postoperatively and result in better mobility, but because of the under-reporting of outcomes and the small number of patients involved, no definite conclusions have been made concerning the possible superiority of any one prosthesis design compared to another. The role of bipolar prostheses and total hip replacement is uncertain. Further well-conducted randomised trials are required (Parker 2003a).

The results from previous studies indicate that undisplaced cervical fractures should be treated with OS (Parker & Blundell 1998, March et al. 1999). Even conservative treatment may result a good outcome (Raaymaakers & Marti 1991, Parker & Myles 1992). There is also a suggestion that very old patients aged over 80 years may be better served by prosthetic replacement (Hui et al. 1994). Displaced fractures are more
complicated, and there is no consensus as to whether a HA or an OS should be the treatment of choice.

In a review of the Cochrane Database, including thirteen trials comparing OS to arthroplasty in the treatment of intracapsular proximal femoral fractures, it was found that OS is associated with less initial operative trauma but has an increased risk of re-operation on the hip. No definite conclusions could be made about the differences in pain and residual disability between OS and arthroplasty. Further, the authors concluded that future studies should concentrate on better reporting the final outcome measures, and there is still a need for studies to define which patient groups are best served by the different treatment methods (Masson 2003).

Conservative treatment is generally accepted only in patients with severe comorbidity and in cases with undisplaced impacted fracture (Raaymaakers & Marti 1991, Parker & Myles 1992). In one retrospective study consisting of patients with severe comorbidity, there was no significant difference in short-term mortality between operatively treated patients and patients treated nonoperatively with immediate mobilisation (Jain et al. 2003).

2.4 Evaluation of hip fracture treatment and outcomes

2.4.1 Details of injury and patients’ general health

In the study of Jarnlo and Thorngren (1993), 63 % of hip fracture patients had fallen indoors, 32 % had experienced one or more falls during the past year, 14 % of female and 70 % of male patients were smokers or former smokers, and 29 % of patients received community home help.

Aharonoff et al. (1998) studied hip fracture patients who were aged 65 years or more, ambulatory, cognitively intact and living at their own homes in New York, USA. They found no seasonal patterns in fracture incidence. Significantly more hip fractures occurred during the afternoon (12:01 pm to 6:00 pm) than during the morning, evening or late night. Only 12% of the fractures occurred outdoors.

Only a few hip fracture patients sustain additional fractures. In the study of Jarnlo and Thorngren (1993) only 7% and in the study of Alfram (1964) 5% had coincidental fractures in the upper extremities.

Strömberg et al. (1997) studied the appearance of cognitive impairment in hip fracture patients older than 64 years during treatment using the Short Portable Mental Status Questionnaire (SPMSQ) (Pfeiffer 1975). The SPMSQ test includes ten questions, each giving one point for a correct answer, the best possible score being ten. Ratings are as follows: lucid (10-8 points), mild cognitive impairment (7-6 pts), moderate cognitive impairment (5-3 pts) and severe cognitive impairment (2-0 pts). At admission, 63% were categorised as lucid and around 10% as severely cognitively impaired. Regardless of the level of impairment, improvement was noted during the hospital stay.
2.4.2 Detailed information on treatment

2.4.2.1 Preoperative delay

Previous studies have yielded conflicting results of the relationship between preoperative delay and mortality (Zuckerman et al. 1995, Dorotka et al. 2003, Casaletto & Gatt 2004, Doruk et al. 2004, Gdalevich et al. 2004, Orosz et al. 2004). Nevertheless, they seem to recommend that patients should be operated within 24 to 48 hours of fracture.

Dolk (1989) reported a clear relationship between the day the patient was admitted and operative delay. Patients who fractured their hips on Sunday to Wednesday usually underwent operation one to three days after the fracture compared to patients who fractured their hips on Friday to Saturday, who were more often operated two to four days after the fracture. No fractures were operated on the day of the fracture. Further, postoperative hospital stay and aftercare were significantly longer for the patients operated on later, but this had no significance effect on complications or mortality.

2.4.2.2 Anaesthesia

Type of anaesthesia does not seem to have an effect on long-term mortality, while regional anaesthesia seems to provide marginal advantages compared to general anaesthesia in terms of early mortality and risk of deep vein thrombosis (Wickström et al. 1982, Urwin et al. 2000).

2.4.2.3 Antibiotic and thromboembolic prophylaxis

Antibiotic prophylaxis is generally recommended for all hip fracture patients to reduce wound infections (Lüthje et al. 2000, Gillespie & Walenkamp 2001). Despite that, a notable proportion of hip fracture patients may not get proper antibiotic prophylaxis in daily practice (Zoutman et al. 1999, Freeman et al. 2002).

Pharmaceutical thromboembolic prophylaxis has been a part of the standard of care for longer than a decade (Zuckerman 1996). Despite that, similarly to antibiotic prophylaxis, a notable proportion of hip fracture patients do not receive thromboembolic prophylaxis (Freeman et al. 2002).

2.4.3 General complications

Thromboembolic complications and deep wound infections were common before systematic thromboembolic and antibiotic prophylaxis. In the studies of Hunter (1969, 1974), prophylactic anticoagulant and antibiotic therapy was not used at all. The rate of
thromboembolic complications was 13% in their earlier and 11% in their later study, and the rate of deep wound infections was 9% in both studies.

In the study of Jalovaara and Virkkunen (1991), the most frequent general complication among patients treated with Austin Moore HA was myocardial infarction (5/185 patients). Only 3 (2%) patients had thromboembolic complications, although only 41 patients received acetylsalicylic acid, 4 received low-dose heparin and 9 received anticoagulant therapy. Seven patients (4%) had deep infections, and 64 patients received prophylactic antibiotics.

In the randomised trial of Parker and Pryor (2000) comparing Austin Moore HA and AO screw OS, all patients received antibiotic and thromboembolic prophylaxis with unfractionated heparin. Two of the 106 patients treated with HA had thromboembolic complications and 4 deep wound infections. The rates of other complications in the two treatment groups combined were as follows: 9% for confusional state, 5% for pneumonia, 4% for urine retention and 2% for gastrointestinal bleeding and congestive heart failure.

In a meta-analysis of 106 reports comparing OS and HA in the treatment of displaced cervical hip fractures, there was no significant difference between the methods concerned with regard to the rates of deep-vein thrombosis and pulmonary embolism (Lu-Yao et al. 1994). The deep infection rate was slightly higher for HA, but this might reflect bias because antibiotics were used prophylactically in only 14% of the studies on HA and 50% of the studies on OS.

2.4.4 Surgical complications and reoperations

Technical failure of the fracture fixation and infections of the wound and fixation material necessitate a second operation, i.e. a reoperation. Reoperation rates, indications and types of reoperation are specific to the type of primary operation used to stabilise the fracture.

Early complications requiring reoperations in HA include wound infections and dislocation of the prosthesis (Jalovaara & Virkkunen 1991, Parker & Pryor 2000). Deep wound infections require revision or excision arthroplasty. Luxation of the prosthesis is treated with closed reduction, but when closed reduction is not successful or the tendency to dislocate persists, total hip arthroplasty is performed whenever possible. Loosening of the endoprosthesis and acetabular erosion are typical of HA and usually treated with total hip arthroplasty. The rates of deep wound infections have varied from 0.5 to 3.8%, the corresponding rates being 1.0 to 7% for dislocation of the prosthesis, 0.6 to 12% for loosening of the prosthesis and 1.1 to 11% for acetabular erosion, resulting in total reoperation rates varying from 4.2 to 24% (Sikorski & Barrington 1981, Kuokkanen & Korkala 1987, Kuokkanen et al. 1988, Kuokkanen et al. 1990, Jalovaara & Virkkunen 1991, Ravikumar & Marsh 2000, Davison et al. 2001, Rogmark et al. 2002). The marked variation is mainly due to variations in the length of follow-up.

Early reoperations after OS of cervical fractures are mostly caused by fracture redisplacement and infection. Generally, the majority of reoperations are revision arthroplasties. Later, non-union and avascular necrosis lead to revision arthroplasty. Local pain around the OS material is treated with removal of the fixation material (Johnson & Crothers 1975, Strömqvist et al. 1992, Parker & Pryor 2000). The rates of fracture
redisplacement have varied between 7 and 24%, the corresponding rates for infection being between 0.5 and 15%, those for non-union between 2 and 28% and those for avascular necrosis between 6 and 27%, and the total reoperation rate varying between 30 and 43% (Johnson & Crothers 1975, Sikorski & Barrington 1981, Strömqvist et al. 1992, Johansson et al. 2000, Ravikumar & Marsh 2000, Davison et al. 2001, Rogmark et al. 2002). As with HA, the variation is mainly caused by variation in the length of follow-up. The reoperation rate is higher after OS than after HA in most comparative studies (Lu-Yao et al. 1994, Johansson et al. 2000, Parker & Pryor 2000, Ravikumar & Marsh 2000, Davison et al. 2001, Rogmark et al. 2002).

In the randomised controlled trial of Parker and Pryor (2000) with three-year follow-up, four patients out of 105 with uncemented Austin Moore HA required a reoperation (indications: one deep wound infection, one fracture around the prosthesis, two cases of prosthetic loosening), while 36 out of 102 patients treated with OS with three parallel cannulated screws required 44 reoperations (indications: five cases of pain around OS material, one fracture around OS material, 24 non-unions, six cases of avascular necrosis).

In the literature, there is no comparison between Austin Moore HA and particularly LIH OS, but reoperations after LIH OS seem to be equally frequent as after other OS methods (Sernbo et al. 1990, Herngren et al. 1992, Lykke et al. 2003).

### 2.4.5 Functional outcome

Most surviving hip fracture patients experience reduced mobility and lose their ability to function independently (Wolinsky et al. 1997, Magaziner et al. 2000, Nurmi et al. 2004). The functional impairment and loss of quality of life compared to control subjects lasts for at least one year after the fracture, presumably longer (van Balen et al. 2001, Boonen et al. 2004).

There is a lack of standardisation of functional outcome measurements between the studies. Standardised outcome measurements are essential for accurate comparisons of different studies (Lu-Yao et al. 1994, Treml & Kroker 2000).

One of the most widely used functional measurements is the Harris Hip Score (Harris 1969, Johansson et al. 2000). It is not a purely functional indicator since it also includes pain, joint deformity and range of hip motion.

#### 2.4.5.1 Walking ability

The main component of functional recovery after a hip fracture is the process of regaining the ability to walk. Reports use various classifications and scores, and there is a lack of standardisation. Further, preoperative walking ability is often ignored when reporting postoperative walking ability.

Factors that have been found to affect negatively the process of regaining the ability to walk include advanced age, male sex, poor pre-fracture walking ability, pre-existing

The percentage of patients regaining pre-fracture level of mobility has been 36-43% at four months after the fracture and 39-82% at one year (Magaziner et al. 1990, Koot et al. 2000, van Balen et al. 2001).

Walking distance, speed, reported reduced walking ability and ability to climb stairs have been used in the categorisation of walking ability (Wolinsky et al. 1997, Kenzora et al. 1998, Koot et al. 2000, Hannan et al. 2001, Rogmark et al. 2002).

Some authors have suggested the use of ambulatory level besides walking ability. Categorisation into community ambulators, household ambulators, non-functional ambulators and non-ambulators has been used. Community ambulators can walk indoors and outdoors for most activities and may need walking aids. Further, household ambulators can walk only indoors, non-functional ambulators can walk only during physical therapy sessions and non-ambulators are wheelchair-bound (Koval & Zuckerman 1994). Independence of ambulation has also been the basis for categorisation (independent, partially independent or dependent) (Imura et al. 2000). Parker and Palmer (1993) developed a mobility score that combines ambulation level and the need for assistive devices or persons (Hardy et al. 1998).

2.4.5.2 Walking aids

Some studies have used walking aids as an independent measurement of outcome, while others have included them in walking ability. Hip fracture increases dependence on walking aids (Keene et al. 1993, Tolo et al. 1999). As with the patient’s walking ability, pain and unsteadiness may account for the increase in the number of walking aids used after the fracture (Tolo et al. 1999).

2.4.5.3 Residential status

Residential status after a hip fracture is not a clearly functional outcome variable, but it reflects the patient’s functional ability. It is particularly important in terms of expenses and quality of life that hip fracture patients return to their own homes whenever possible, instead of being institutionalised or hospitalised. In previous studies, the proportion of patients able to return home has ranged from 60% to 79% during the first postoperative four months and from 28% to 76% during the first postoperative year (Holmberg & Thorngren 1985, Dolk 1989, Borgquist et al. 1990, Keene et al. 1993, Nurmi et al. 2004). The wide range is partly due to differences in the availability of home help services and institutions for the elderly and also to cultural differences in the emphasis placed on returning home and the involvement of family members.

Factors identified to cause a need for institutional care include advanced age, poor pre- and post-fracture walking ability, pre-existing dementia, comorbidities, need for assistance in the activities of daily living and trochanteric fracture (Ceder et al. 1980, Dolk 1989, Borgquist et al. 1990, Marottioli et al. 1994, Parker & Palmer 1995, Svensson
et al. 1996, Cree et al. 2000). The current emphasis on short hospital stay and early discharge has a negative effect on the ability to return home directly (Jalovaara et al. 1992). The most significant variables for discharge to the patient’s own home have turned out to be the ability to walk two weeks after the surgery, living with someone and good general health (Thorngren et al. 1993).

2.4.5.4 Activities of daily living

To achieve functional independence, the ability to perform certain activities of daily living (ADL) is necessary. Some authors tend to divide ADL into subcategories. Zuckerman (1996) divided ADL into two categories: basic (BADL) and instrumental ADL (IADL). BADL include feeding, bathing, dressing and toileting, while IADL include shopping, food preparation, banking, laundry, light housework and use of public transportation. Zuckerman et al. (2000) also developed the Functional Recovery Score, where BADL and IADL are combined into mobility scores. All scores are weighted based on a questionnaire administered to senior citizens.

Another solution is to divide ADL into instrumental ADL and physical ADL (PADL) and to further divide PADL into upper extremity physical ADL (UPADL) and lower extremity physical ADL (LPADL). UPADL includes putting on a shirt or a blouse, buttoning a shirt or a blouse, feeding self and grooming. LPADL includes walking 10 feet, walking one block, climbing five steps, getting into a car, getting in or out of bed, rising from an armless chair, putting on pants, putting socks and shoes on both feet, getting in or out of a bath or shower, taking a bath, shower or sponge bath and getting on or off the toilet (Magaziner et al. 2000).

Multidimensional Functional Assessment Questionnaire (MFAQ) of the Older American Resources and Services (OARS) has seven PADL questions, which include eating, dressing, grooming, walking, transferring, bathing and using toilet, and seven IADL questions, which include taking medication, using the telephone, mobility, shopping, preparing meals, doing housework and handling money (Young et al. 1996). It has been used in hundreds of studies (George & Fillenbaum 1985). Modifications of it have also been made (Kenzora et al. 1998).

Katz Index of ADL has also been used frequently (Katz et al. 1963, Svensson et al. 1996, Beloosesky et al. 2001, Freeman et al. 2002). It includes six functions: bathing, dressing, toileting, transfer, continence and feeding.

The Barthel index has similarly been used in the measurement of functioning (Cree et al. 2001). It includes feeding, bathing and dressing but also walking ability, stairs, bowel and bladder control and ability to move onto and off toilet (Mahoney & Barthel 1965). It has also been used after modification to fit better hip fractures studies (Davison et al. 2001).

Furthermore, modified d’Aubigne and Postel hip score (Charnley 1972, Dorr et al. 1986), Functional Status Index (Jette 1980, Kenzora et al. 1998), Functional Independence Measure (FIM) (Beloosesky et al. 2001), Rapid Disability Rating Scale (RDRS) (Boonen et al. 2004) and modified Townsend score (Townsend 1979, Freeman et al. 2002) have been used in studies on hip fractures.
Factors reported to be predictive of the recovery of ADL are younger age, absence of co-morbidities and pre-existing dementia and greater contact by the patient with his or her social network (Magaziner et al. 1990, Mozes et al. 1999, Koot et al. 2000, Cree et al. 2001).

In the study of Koval et al. (1998), 59% of patients who were 65 years or older with a nonpathological hip fracture without severe dementia and were ambulatory and home-dwelling before sustaining the fracture had recovered their basic ADL function at 3 months, while 71% had done so at 6 months and 73% at 12 months. Similarly, 34% had recovered their instrumental ADL at 3 months, 42% at 6 months and 48% at 12 months. For comparison, in the study of van Balen et al. (2001), 17% had achieved their pre-facture level of activities of daily living at four months. In a recent Finnish study, the functional abilities of hip fracture patients regained to four months postoperatively and decreased slightly, but not significantly, by 12 months (Nurmi et al. 2004).

2.4.6 Pain

Postoperative pain has been associated with the development of postoperative functional dependence (Feldt & Oh 2000), and the risk of functional dependence may be reduced by 35% in mentally unimpaired patients by treating hip pain (Cree et al. 2001).

The proportion of patients reporting pain in the injured hip varies from 33 to 76% at four months and from 25 to 43% at one year after fracture (Skinner et al. 1989, Jalovaara et al. 1992, Parker & Pryor 2000, Cserháti et al. 2002, Rogmark et al. 2002, Rosell & Parker 2003). The proportion of patients reporting pain in the injured hip increases over time: in the study of Parker and Pryor (2000), the proportion of patients reporting any pain in the injured hip was 61% at one, 80% at two and 87% at three years after HA and, respectively, 64%, 73% and 75% after OS.

2.4.7 Mortality

Mortality is one of the most frequently studied and reported measurements of outcome in studies on hip fractures. Hip fracture causes excess mortality during the first 2 to 6 months following the fracture, after which death rates correspond to those of the general population (Dahl 1980, Magaziner et al. 1989, Jalovaara & Virkkunen 1991). This excess mortality is higher among men than women in comparison to the general population (Lüthje et al. 1995b).

Mortality has varied from 14 to 24 percent at four months after fracture and from 17 to 34 percent at one year (Dolk 1989, Magaziner et al. 1989, van Balen et al. 2001, Cserháti et al. 2002, Parker et al. 2002b, Rosell & Parker 2003, Nurmi et al. 2004).

Factors noted to be associated with mortality include advanced age, male sex, medical and psychiatric comorbidities, institutional living and low level of pre-fracture function (Dahl 1980, Kuokkanen & Korkala 1992, Marottoli et al. 1994, Koval & Zuckerman 1994, Mozes et al. 1999, Parker et al. 2002b). Cardio- and cerebrovascular diseases,
pulmonary embolism and pneumonia are the predominant immediate causes of death (Holmberg et al. 1986, Chiu & Lo 1996).

Mortality after a hip fracture has been decreasing. Possible factors contributing to this include better medical management, better implants that allow rapid mobilization, emphasis on early physical therapy and advances in anaesthesia (Kernek et al. 1990). There are also some findings suggesting that the mortality of hip fracture patients has risen over the years because of the mean age of hip fracture patients has also risen (Nurmi et al. 2004).

2.4.8 Length of follow-up

In studies on surgical treatment and rehabilitation of hip fractures, follow-up times have varied from a few weeks to several years, and there seems to be no consensus on the adequate follow-up time. Some studies have indicated that mobility and ADL do not improve, and the proportion of patients living independently does not increase after four months following the surgery (Ceder et al. 1980, Borgquist et al. 1990, Thorngren 1991, Koot et al. 2000). On the contrary, there are studies suggesting that the recovery of functions is achieved later, by six to twelve months after the fracture (Magaziner et al. 1990, Koval et al. 1998, Magaziner et al. 2000). It has also been found that PADL functions recuperate earlier, before four months, while IADL functions recuperate later by six months (Young et al. 1996).

Studies on OS and HA have shown their typical failures, which occur in sequence, even several years after the primary treatment (Ravikumar & Marsh 2000). Further, the occurrence of later complications cannot be predicted during a short follow-up. Reoperations after HA usually occur later than after OS, as in the prospective randomised study of Ravikumar and Marsh (2000) comparing HA, THA and OS during 13 years of follow-up. The average time from primary operation to reoperation was 9.3 months after OS and 22.1 months after HA.

There is a consistent review finding suggesting that, two to six months after the injury, the mortality among hip fracture patients is no different from that among non-fractured controls (Dahl 1980, Kreutzelldt et al. 1984, Holmberg et al. 1986, Magaziner et al. 1989, Wolinsky et al. 1997, Forsén et al. 1999).

2.4.9 Comparisons between hospitals

Studies comparing medical centres treating hip fractures have shown different ways to solve the overall treatment of hip fractures. The use of different treatment methods is based on choices made by the orthopaedic surgeons but strongly influenced by traditions and the structural facilities for local medical care (Jalovaara et al. 1992).

In the first study comparing two Swedish hospitals (Sundsvall and Lund) and one Finnish hospital (Oulu), there were differences between the Swedish hospitals in patient characteristics, treatments and outcomes, favouring treatment in Lund (Jalovaara et al. 1992). Later, when Berglund-Rödén et al. (1994) compared the same two Swedish
hospitals and six hospitals from the Netherlands, the functional outcome was very similar compared to the earlier findings in the two Swedish hospitals. In the last study, comparing the hospitals in Sundsvall and Lund and one hospital in Hungary (Budapest), the surgical methods had changed slightly in Sundsvall, but the differences in outcomes still remained more or less unchanged (Cserháti et al. 2002). As a consequence of the last comparison, Sundsvall changed their surgical methods.

In a prospective Finnish study, the demographic data, fracture types and modes of treatment in 309 patients with an acute hip fracture were analysed in six hospitals located in two health care districts (Lüthje et al. 1992). There were differences between the two health care districts in fracture types, methods used to treat cervical fractures, the average duration of hospitalisation for primary treatment and mortality during primary treatment.

In a study of eight hospitals in East Anglia, patient characteristics were similar between the hospitals, but there were significant differences in treatments, complications and outcomes, including mortality (Todd et al. 1995). Logistic regression analysis failed to identify a single factor or aspect of practice accounting for this difference, but the authors suggested that it may have been associated with the cumulative effects of several aspects of the organisation of treatment and the management of hip fractures, including thromboembolic prophylaxis, antibiotic prophylaxis and early mobilisation. Later, the same hospitals participated in a re-audit (Freeman et al. 2002). Use of pharmaceutical thromboembolic prophylaxis and early mobilisation had been increased and complications had decreased. Mortality and functional outcomes did not change. After these findings, the authors recommend repeated audit cycles and comparisons of centres treating hip fractures to enable continuous quality improvement in order to reach and then improve standards in the care of hip fractures.

In Israel, three hospitals treating hip fractures were compared (Mozes et al. 1999). There were no significant differences between the centres in mortality and ADL, but significant differences existed in complications and length of hospitalisation in the crude results. After multivariate analyses, there were differences between the centres in all four measurements, namely mortality, ADL, complications and length of hospitalisation.

Similar findings of the importance of multivariate analyses and multidimensional measurements were obtained in the studies of Hannan et al. (2001) and Parker et al. (2002b). In the former study, it was noted that one hospital can have good results in one outcome and poor in another, while the latter indicated that the significant difference between the hospitals in observed crude mortality ceased to exist when confounding factors were considered in multivariate analysis.

2.4.10 Comparisons between different countries

There are some studies comparing the treatments of hip fractures in different countries. Jalovaara et al. (1992) found differences in the choice of treatment and rehabilitation routines between Sweden and Finland.

In a study comparing the treatments of hip fractures in six hospitals in Rotterdam, Netherlands, and two hospitals in Sweden, it was found that functional outcome after four months was very consistent between the countries irrespective of the hospital resources.
and the choices made concerning the surgical method and the rehabilitation routines (Berglund-Rödén et al. 1994).

A comparison carried out between Hungary and Sweden revealed significant differences in outcomes between the countries and was advantageous for not only patients but also for health care economy (Cserháti et al. 2002). As a result, the centres in both countries changed their treatment methods.

### 2.4.11 Standardised audits

Improvement of patient care through clinical audits has gained attention. In Sweden, a registration project called Rikshöft (“National Hip”) was started at the turn of the 1990’s by recording the treatment data and outcomes of all hip fractures occurring in Sweden (Thorngren 1991). This standardised method has been also used to compare treatments in different countries (Jalovaara et al. 1992, Berglund-Rödén et al. 1994, Kitamura et al. 1998, Cserháti et al. 2002).

At about the same time, an audit group in East Anglia developed another standard proforma for hip fractures (Todd et al. 1993). It was used to compare the treatments of hip fractures in East Anglian hospitals (Todd et al. 1995, Freeman et al. 2002).

Following collaboration between these two groups and the recruitment of some new participants, a new Hip Fracture Audit group was appointed in 1995 (Parker et al. 1998). This group developed a standardised audit protocol for hip fracture treatment called SAHFE (Standardised Audit of Hip Fracture Treatment in Europe). The core data set includes three basic forms for recording the patient’s basic data, including pre- and postoperative functionality and residential status, preoperative morbidity categorised using ASA classification (American Society of Anaesthesiologists 1963), fracture and treatment, reoperations and mortality. Follow-up takes place at four months and, optionally, at one year postoperatively. The SAHFE protocol also includes an optional extended data set for more detailed functional assessment, fracture classification and treatment details. The core SAHFE data set has been used in a few descriptive studies (Rosell & Parker 2003, Scheerlinck et al. 2003).
3 Aims

1. To determine whether HA or OS should be the treatment of choice for specific age groups in the treatment of cervical hip fractures in the elderly.
2. To compare the characteristics, treatment and outcomes of hip fracture patients treated in Finland (Oulu) and Great Britain (Peterborough) for purposes of quality control and to obtain information for the development of the treatment of hip fractures.
3. To compare the hip fracture treatment provided in six hospitals in Finland for quality control and to obtain information for the development of the treatment of hip fractures.
4. To test the suitability of the enlarged multicentre hip fracture study inquiry (extended SAHFE data set) for studies of hip fractures.
5. To evaluate the suitability of four-month follow-up to studies on the treatment and rehabilitation of hip fractures using function, residence and activities of daily living as the main outcome measurements.
4 Patients and methods

4.1 Functional outcomes after HA and OS in the treatment of cervical hip fractures especially in view of different age groups

The data of all hip fracture patients aged 50 years or over, excluding pathological fractures, admitted into the University Hospitals of Lund in Sweden and Oulu in Finland during 1989 – 1996 were collected and computerised using standardised hip fracture study forms (appendix I) (Thorngren 1991, Jalovaara et al. 1992, Berglund-Rödén et al. 1994). In both hospitals, the study nurses filled in the form 1 concerning the basic information of the patient, fracture and treatment during the hospital stay. The patients themselves filled in the postoperative form 2 at four months. The study nurses completed the inquiries for missing data by a telephone interview if necessary. Mortality data were obtained from Finnish Census Register in Finland and from National Central Bureau of Statistics in Sweden for a one-year period, and reoperations were recorded for up to one year on a special form 3.

Both hospitals treated their patients with cervical hip fractures using their primary mode of treatment: in Oulu 546 patients were treated with the Austin Moore uncemented HA, and in Lund 1277 patients were treated with OS with two LIH hook pins. The patients were matched for the important prognostic factors: age (± two years), sex, residence and walking ability. Thus, 446 matched pairs were found (Table 1).

The data processing and statistical analyses were performed by a statistician using the SPSS statistical software (SPSS, SPSS Inc., 1998, 8.0.2 Standard Version for Windows). For the analysis of the different age groups, the groups were made as equal in size as possible in view of the aspects of clinical practice, and the outcome variables of the groups were analysed as dichotomous. All statistical analyses were performed as described by Breslow and Day (1980) for matched-pair analyses, comparing the members of each pair with McNemar’s test for dichotomous variables, Wilcoxon’s signed ranks test for continuous variables and the marginal homogeneity test for multiple categorical variables.
Table 1. Patient characteristics after cross-matching.

<table>
<thead>
<tr>
<th>Type of operation</th>
<th>HA</th>
<th>OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>446</td>
<td>446</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td>Female</td>
<td>353</td>
<td>353</td>
</tr>
<tr>
<td>Mean age (range)</td>
<td>81 (56-98)</td>
<td>81 (55-100)</td>
</tr>
<tr>
<td>Admitted from</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own home</td>
<td>281</td>
<td>281</td>
</tr>
<tr>
<td>Convalescent home or full-service unit</td>
<td>119</td>
<td>119</td>
</tr>
<tr>
<td>Geriatric department or nursing home</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>Acute hospital</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Walking ability before the fracture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alone outdoors</td>
<td>228</td>
<td>228</td>
</tr>
<tr>
<td>Outdoors only accompanied</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Alone only indoors</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Indoors only accompanied</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Unable to walk</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Walking aids before the fracture *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>251</td>
<td>239</td>
</tr>
<tr>
<td>One aid</td>
<td>90</td>
<td>73</td>
</tr>
<tr>
<td>Two aids</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Rollator/walking frame</td>
<td>85</td>
<td>104</td>
</tr>
<tr>
<td>Wheelchair/bedbound</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Fracture type **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undisplaced cervical</td>
<td>56</td>
<td>130</td>
</tr>
<tr>
<td>Displaced cervical</td>
<td>390</td>
<td>307</td>
</tr>
</tbody>
</table>

* Data of 5 patients missing in OS group. ** Data of 9 patients missing in OS group.

4.2 Hip fracture treatment and outcomes in Finland and Great Britain

In Oulu University Hospital in Finland and in Peterborough District Hospital in Great Britain, all patients with a hip fracture admitted between 1989 and 1997 were registered using the same standardised hip fracture study forms and procedures as described above. Patients aged less than 50 years, pathological fractures and subtrochanteric fractures were excluded. Follow-up was performed at four months as described above. Re-operations and mortality data were recorded for a one-year period after the fracture. The patient characteristics are listed in Table 2.
Table 2. Patient characteristics.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Oulu</th>
<th>Peterborough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>1702</td>
<td>2083</td>
</tr>
<tr>
<td>Mean age</td>
<td>78</td>
<td>80</td>
</tr>
<tr>
<td>Female (%)</td>
<td>74</td>
<td>79</td>
</tr>
<tr>
<td>Admitted from (%)</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Own home</td>
<td>62</td>
<td>69</td>
</tr>
<tr>
<td>Sheltered housing</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Residential</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>Nursing home</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Acute hospital</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Living alone (%)</td>
<td>56</td>
<td>47</td>
</tr>
<tr>
<td>Walking ability (%)</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Alone outdoors</td>
<td>54</td>
<td>50</td>
</tr>
<tr>
<td>Outdoors only accompanied</td>
<td>11</td>
<td>29</td>
</tr>
<tr>
<td>Alone indoors</td>
<td>25</td>
<td>18</td>
</tr>
<tr>
<td>Indoors only accompanied</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Unable to walk</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Walking aids (%)</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>None</td>
<td>56</td>
<td>57</td>
</tr>
<tr>
<td>One aid</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Two aids</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Walking frame/rollator</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>Wheelchair/bedbound</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Fracture type (%)</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Undisplaced cervical</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>Displaced cervical</td>
<td>45</td>
<td>49</td>
</tr>
<tr>
<td>Basicervical</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Trochanteric two-fragment</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Trochanteric multi-fragment</td>
<td>22</td>
<td>28</td>
</tr>
</tbody>
</table>

* p < 0.001

Statistical analysis was performed by a statistician using the SPSS statistical software (SPSS for Windows 9.0.1). Chi-square test was performed for categorical variables, Student’s t-test for continuous variables with normal distribution and Mann-Whitney U-test for other continuous variables.

4.3 Hip fracture treatment and functional outcomes in six hospitals in Finland

Data on about 200 consecutive non-pathological hip fracture patients aged 50 years or over per hospital were collected between August 1997 and February 2001 in six hospitals
in Finland: Joensuu, Kajaani, Kemi, Kokkola, Rovaniemi and Oulu. The first five hospitals are central hospitals providing special health care for the people living in their catchment areas. Oulu University Hospital serves as a central hospital for its own primary catchment area and also provides highly specialised care for the whole of Northern Finland.

Table 3. Patient characteristics of participating hospitals.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Joensuu</th>
<th>Kajaani</th>
<th>Kemi</th>
<th>Kokkola</th>
<th>Oulu</th>
<th>Rovaniemi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>187</td>
<td>199</td>
<td>192</td>
<td>190</td>
<td>213</td>
<td>198</td>
</tr>
<tr>
<td>Mean age (range)</td>
<td>78 (51-99)</td>
<td>81 (56-99)</td>
<td>79 (50-99)</td>
<td>79 (50-96)</td>
<td>79 (53-102)</td>
<td>78 (52-99)</td>
</tr>
<tr>
<td>Female (%)</td>
<td>73</td>
<td>77</td>
<td>65</td>
<td>69</td>
<td>76</td>
<td>69</td>
</tr>
<tr>
<td>Admitted from (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own home</td>
<td>53</td>
<td>67</td>
<td>62</td>
<td>49</td>
<td>59</td>
<td>59</td>
</tr>
<tr>
<td>Sheltered housing</td>
<td>7</td>
<td>6</td>
<td>9</td>
<td>7</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Old peoples home</td>
<td>22</td>
<td>18</td>
<td>22</td>
<td>28</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Permanent hospital inpatient</td>
<td>10</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Rehabilitation unit</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Acute hospital</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td>12</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Living alone (%)</td>
<td>38</td>
<td>39</td>
<td>43</td>
<td>27</td>
<td>35</td>
<td>24</td>
</tr>
<tr>
<td>Walking ability (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alone outdoors</td>
<td>48</td>
<td>45</td>
<td>54</td>
<td>52</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>Outdoors only accompanied</td>
<td>5</td>
<td>10</td>
<td>12</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Alone indoors only</td>
<td>37</td>
<td>27</td>
<td>26</td>
<td>31</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Indoors only accompanied</td>
<td>7</td>
<td>15</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Unable to walk</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Walking aids (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>56</td>
<td>59</td>
<td>59</td>
<td>51</td>
<td>44</td>
<td>48</td>
</tr>
<tr>
<td>One aid</td>
<td>15</td>
<td>16</td>
<td>13</td>
<td>11</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Two aids</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Walking frame/rollator</td>
<td>23</td>
<td>20</td>
<td>23</td>
<td>33</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Wheelchair/bedbound</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>ASA grade (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>3</td>
<td>1</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>10</td>
<td>9</td>
<td>27</td>
<td>16</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>III</td>
<td>60</td>
<td>57</td>
<td>44</td>
<td>67</td>
<td>67</td>
<td>59</td>
</tr>
<tr>
<td>IV</td>
<td>26</td>
<td>31</td>
<td>21</td>
<td>15</td>
<td>19</td>
<td>15</td>
</tr>
<tr>
<td>V</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Trained nurses collected the data using standardized hip fracture study forms (appendix II) (Parker et al. 1998, Rosell & Parker 2003, Scheerlinck et al. 2003). The nurses attended a three-day training programme at Oulu. On admission, a study nurse recorded the baseline personal information by interviewing the patient and, if necessary, the patient’s relatives or the staff of the relevant institution. Surgical data and ASA grades were drawn from patient files and operation registers. The follow-up assessment was carried out four months after the fracture, the patients filled in the follow-up forms, and if
necessary, the nurse completed them during a telephone interview. In a case of reoperation, the nurse filled in a special form. Mortality data were obtained from Finnish Census Register.

All data from the participating hospitals was computerised, merged and analysed by a statistician using the SPSS statistical software (SPSS for Windows 11.5). Chi-square test was performed for categorical variables and Kruskal-Wallis test for continuous variables to obtain statistical significances. The Kaplan-Meier estimates of survival curves were compared by the log rank test. Cox regression analysis was used to compare survival rates between the centres adjusted for confounding factors. The forward stepwise method was used with indicator contrast. Logistic regression analysis was used to compare postoperative walking ability and residence between the centres using the forward stepwise method. The preoperative variables used in all multivariate analyses were centre, age, sex, residence, walking ability, morbidity, side and type of fracture, delay of operation, method of treatment and length of stay in primary hospital.

### 4.4 SAHFE (Standardised Audit for Hip Fractures in Europe) extended data collection set and its suitability to studies of hip fractures

Information on 238 consecutive non-pathological hip fracture patients aged 50 years or over between September 28, 1997 and August 28, 1998 admitted into Oulu University Hospital was collected using the same standardised hip fracture study forms and procedure as in the study described above. Moreover, the extended SAHFE data set inquiry (appendix III) was applied to all patients. This contains inquiries about the patient’s abilities, additional health information, including a few laboratory parameters, details of the injury, treatment, fracture and reduction and complications. The study nurse collected the additional information from patient files and surgical registers and by interviewing the patients and their relatives. An orthopaedic surgeon reviewed all pre- and postoperative roentgenograms and evaluated types, grades and indexes. Four months after the fracture, the patients filled in follow-up forms including similar questions on their abilities as on admission. The study nurse examined, completed and validated the information on the forms by interviewing the patients themselves or their relatives or the staff of the relevant institution over the telephone if necessary.
Table 4. Patient characteristics and treatment (n=238).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (range)</td>
<td>78 (50-102)</td>
</tr>
<tr>
<td>Female (%)</td>
<td>78</td>
</tr>
<tr>
<td>Admitted from (%)</td>
<td></td>
</tr>
<tr>
<td>Own home</td>
<td>59</td>
</tr>
<tr>
<td>Sheltered housing</td>
<td>5</td>
</tr>
<tr>
<td>Old peoples home</td>
<td>26</td>
</tr>
<tr>
<td>Permanent inpatient</td>
<td>4</td>
</tr>
<tr>
<td>Rehabilitation unit</td>
<td>1</td>
</tr>
<tr>
<td>Acute hospital</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
</tr>
<tr>
<td>Living alone (%)</td>
<td>32</td>
</tr>
<tr>
<td>Walking ability (%)</td>
<td></td>
</tr>
<tr>
<td>Alone outdoors</td>
<td>57</td>
</tr>
<tr>
<td>Outdoors only accompanied</td>
<td>11</td>
</tr>
<tr>
<td>Alone indoors only</td>
<td>21</td>
</tr>
<tr>
<td>Indoors only accompanied</td>
<td>9</td>
</tr>
<tr>
<td>Unable to walk</td>
<td>3</td>
</tr>
<tr>
<td>Walking aids (%)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>48</td>
</tr>
<tr>
<td>One aid</td>
<td>12</td>
</tr>
<tr>
<td>Two aids</td>
<td>1</td>
</tr>
<tr>
<td>Walking frame/rollator</td>
<td>33</td>
</tr>
<tr>
<td>Wheelchair/bedbound</td>
<td>5</td>
</tr>
<tr>
<td>ASA grade (%)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>14</td>
</tr>
<tr>
<td>III</td>
<td>66</td>
</tr>
<tr>
<td>IV</td>
<td>16</td>
</tr>
<tr>
<td>V</td>
<td>2</td>
</tr>
<tr>
<td>Fracture type (%)</td>
<td></td>
</tr>
<tr>
<td>Undisplaced intracapsular</td>
<td>8</td>
</tr>
<tr>
<td>Displaced intracapsular</td>
<td>53</td>
</tr>
<tr>
<td>Basicervical</td>
<td>2</td>
</tr>
<tr>
<td>Trochanteric two-fragment</td>
<td>17</td>
</tr>
<tr>
<td>Trochanteric multi-fragment</td>
<td>18</td>
</tr>
<tr>
<td>Subtrochanteric</td>
<td>2</td>
</tr>
<tr>
<td>Method of treatment (%)</td>
<td></td>
</tr>
<tr>
<td>OS</td>
<td>13</td>
</tr>
<tr>
<td>HA</td>
<td>43</td>
</tr>
<tr>
<td>THA</td>
<td>3</td>
</tr>
<tr>
<td>Gamma nail</td>
<td>35</td>
</tr>
<tr>
<td>SHS</td>
<td>3</td>
</tr>
<tr>
<td>Girdlestone</td>
<td>1</td>
</tr>
<tr>
<td>Conservative</td>
<td>1</td>
</tr>
</tbody>
</table>
The patient characteristics and information on fracture and treatment are shown in table 4. The general medical condition of four patients was so poor that they could not be operated.

Data organisation was done using the special SAHFE program, and the statistical analyses were performed by a statistician using the SPSS statistical software (SPSS for Windows 8.0.2). A marginal homogeneity test was performed for multicategorical variables, McNemar tests for binomial variables and Wilcoxon’s signed-ranks test for continuous variables to assess the statistical significances of the functional outcomes between the baseline and the four-month follow-up.

4.5 Suitability of four-month follow-up in studies of hip fracture treatment and rehabilitation

The data of 196 consecutive hip fracture patients aged 50 years or over with non-pathological hip fractures admitted into the Oulu University Hospital between August 1, 1998 and July 31, 1999 were collected using the standardised multicentre hip fracture study forms (appendix II) and the same procedures as in study above. An additional twelve-month follow-up was performed, the same information was collected and the same procedure used as in the four-month follow-up.

The prefracture patient characteristics are shown in table 5. Most patients were discharged from the primary hospital to rehabilitation units or health centre hospitals, and only 13 patients were primarily discharged into their own homes. Two patients died in the orthopaedic ward during their primary stay. The mean duration of hospitalisation on the orthopaedic ward was 7.7 days.

Statistical analyses were performed by a statistician using the SPSS statistical software (SPSS for Windows 9.0.1). The comparison of the different checkpoints was carried out using analysis of repeated measures, which excludes data on patients not alive at the last follow-up. Statistical significances were calculated using a marginal homogeneity test for categorical variables and Wilcoxon’s signed ranks test for continuous variables. A two-sided probability level of 0.05 or less was deemed to indicate statistical significance.
Table 5. Patient characteristics (n=196).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (range)</td>
<td>79 (51-99)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>44</td>
</tr>
<tr>
<td>Female</td>
<td>152</td>
</tr>
<tr>
<td>Residential status</td>
<td></td>
</tr>
<tr>
<td>Own home</td>
<td>121</td>
</tr>
<tr>
<td>Sheltered housing</td>
<td>6</td>
</tr>
<tr>
<td>Institutional care</td>
<td>14</td>
</tr>
<tr>
<td>Health centre hospital</td>
<td>34</td>
</tr>
<tr>
<td>Permanent hospital inpatient</td>
<td>12</td>
</tr>
<tr>
<td>Acute hospital</td>
<td>9</td>
</tr>
<tr>
<td>Walking ability</td>
<td></td>
</tr>
<tr>
<td>Alone outdoors</td>
<td>121</td>
</tr>
<tr>
<td>Outdoors only accompanied</td>
<td>9</td>
</tr>
<tr>
<td>Alone indoors only</td>
<td>53</td>
</tr>
<tr>
<td>Indoors only accompanied</td>
<td>7</td>
</tr>
<tr>
<td>Unable to walk</td>
<td>6</td>
</tr>
<tr>
<td>Walking aids</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>96</td>
</tr>
<tr>
<td>One aid</td>
<td>23</td>
</tr>
<tr>
<td>Two aids</td>
<td>3</td>
</tr>
<tr>
<td>Walking frame/rollator</td>
<td>63</td>
</tr>
<tr>
<td>Wheelchair/bedbound</td>
<td>11</td>
</tr>
<tr>
<td>ASA grade *</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>27</td>
</tr>
<tr>
<td>III</td>
<td>124</td>
</tr>
<tr>
<td>IV</td>
<td>37</td>
</tr>
<tr>
<td>Type of fracture</td>
<td></td>
</tr>
<tr>
<td>Undisplaced intracapsular</td>
<td>27</td>
</tr>
<tr>
<td>Displaced intracapsular</td>
<td>97</td>
</tr>
<tr>
<td>Basicervical</td>
<td>3</td>
</tr>
<tr>
<td>Trochanteric two-fragment</td>
<td>30</td>
</tr>
<tr>
<td>Trochanteric multifragment</td>
<td>33</td>
</tr>
<tr>
<td>Subtrochanteric</td>
<td>6</td>
</tr>
</tbody>
</table>

* Data of 5 patients missing
5 Results

5.1 Functional outcomes after HA and OS in the treatment of cervical hip fractures especially in view of different age groups

At four months, more of the OS patients were able to live in their own homes (p=0.002), to walk alone outdoors (p=0.007), to walk without walking aids (p=0.002) and considered themselves able to walk equally well as before the fracture (p<0.001) compared to the HA patients.

Reoperation rates at four months were not significantly different between the groups, but by one year, the OS patients had had twice as many reoperations as the HA patients (p<0.001). Overall mortality rates at four months (p=0.014) and at one year (p=0.043) were higher in the HA group than in the OS group.

Among patients aged 55-75 years, OS resulted in statistically significantly lower one-year mortality but a 2.4-fold reoperation rate (NS) compared to HA. Among patients aged 76-80 years, OS was associated with a lesser need for walking aids (p<0.05), less pain (p<0.05) and lower four-month mortality (p<0.05). In the other age groups, there were no statistically significant differences in the outcome variables between HA and OS.

5.2 Hip fracture treatment and outcomes in Finland and Great Britain

Uncemented Austin Moore HA was the treatment of choice for cervical fractures in Oulu, whereas in Peterborough the HA / OS ratio was close to 1. For trochanteric fractures, the Sliding Hip Screw (SHS) was the only method used in Peterborough, while in Oulu one third of trochanteric fractures were treated using SHS and the rest using a short Gamma nail.

The mean period of hospitalisation in the primary orthopaedic ward was longer in Peterborough than in Oulu because the management of patients following surgery was
different between the two centres: in Peterborough, patients were rehabilitated in the primary hospital and discharged to their original place of living directly from the orthopaedic ward. In Oulu, patients were discharged early from the orthopaedic ward into health centre hospitals for rehabilitation.

At four months’ follow-up, more patients were living at their own homes in Peterborough than in Oulu. One-year overall mortality was 27.1% in Peterborough and 24.9% in Oulu (NS). The mortality of patients with cervical fractures was not statistically different between the centres, but mortality after trochanteric fractures was statistically significantly lower in Oulu (p=0.003).

### 5.3 Hip fracture treatment and functional outcomes in six hospitals in Finland

The delay from admission to operation varied between the centres, being shortest in Kajaani. HA was applied to most patients with cervical fractures in all hospitals. For trochanteric fractures, Joensuu and Kajaani used almost exclusively SHS, while Gamma nail was the treatment of choice in Oulu. The mean length of hospitalisation for primary treatment varied significantly, being shortest in Kajaani and longest in Kemi. Longer hospitalisation times resulted in higher rates of discharge directly into patients’ own homes.

At four months’ follow-up, the proportion of patients living at their own homes was highest in Kemi. Patients regained their walking ability most often in Oulu, where nearly a twofold number of patients were able to walk alone outdoors compared to Kajaani. On the other hand, the use of walking aids, especially walking frame, was more common in Oulu than in the other centres. No significant differences were observed in the reoperation rate between the six hospitals.

According to logistic regression analysis, preoperative residence, walking ability, morbidity, age and length of stay in the primary hospital were predictive of walking ability at four months. Further, the patients treated in Kajaani and Rovaniemi had a slightly poorer walking ability at four months’ follow-up. Preoperative residence, walking ability, morbidity and age were predictive of residential status at four months, and no significant differences were observed between the centres.

Figure 4 shows the estimated mortality data of the centres. The difference in estimated mortality between the centres was statistically non-significant according to a log rank test (p=0.567). In Cox regression analysis, age, sex, walking ability and morbidity prior to fracture were associated with the risk of death and showed slightly higher mortality in Oulu and Rovaniemi (Table 6).
Fig. 4. Kaplan-Meyer survival curve.
Table 6. Cox regression analysis. Relative risk of mortality.

<table>
<thead>
<tr>
<th>Variable</th>
<th>RR</th>
<th>95% CI</th>
<th>P-value to remove</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.06</td>
<td>1.04 – 1.07</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.58</td>
<td>0.48 – 0.68</td>
<td></td>
</tr>
<tr>
<td>Walking ability prior to fracture</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alone outdoors</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoors only accompanied</td>
<td>1.37</td>
<td>1.01 – 1.87</td>
<td></td>
</tr>
<tr>
<td>Alone indoors only</td>
<td>1.67</td>
<td>1.37 – 2.04</td>
<td></td>
</tr>
<tr>
<td>Indoors only accompanied</td>
<td>1.72</td>
<td>1.31 – 2.27</td>
<td></td>
</tr>
<tr>
<td>Unable to walk</td>
<td>1.97</td>
<td>1.13 – 3.42</td>
<td></td>
</tr>
<tr>
<td>ASA category</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>1.67</td>
<td>0.66 – 4.21</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>2.65</td>
<td>1.08 – 6.49</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>4.13</td>
<td>1.67 – 10.2</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>4.36</td>
<td>1.29 – 14.7</td>
<td></td>
</tr>
<tr>
<td>Centre</td>
<td></td>
<td></td>
<td>0.058</td>
</tr>
<tr>
<td>Joensuu</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kajaani</td>
<td>1.08</td>
<td>0.82 – 1.44</td>
<td></td>
</tr>
<tr>
<td>Kemi</td>
<td>1.30</td>
<td>0.96 – 1.77</td>
<td></td>
</tr>
<tr>
<td>Kokkola</td>
<td>1.00</td>
<td>0.74 – 1.35</td>
<td></td>
</tr>
<tr>
<td>Oulu</td>
<td>1.37</td>
<td>1.03 – 1.81</td>
<td></td>
</tr>
<tr>
<td>Rovaniemi</td>
<td>1.38</td>
<td>1.03 – 1.84</td>
<td></td>
</tr>
</tbody>
</table>

5.4 SAHFE (Standardised Audit for Hip Fractures in Europe) extended data collection set and its suitability to studies of hip fractures

The majority (89%) of hip fracture patients had one or more associated diseases, especially cardiovascular conditions, diabetes mellitus, respiratory diseases, previous stroke and renal diseases. The cognitive function screening test (SPMSQ) showed 57% of the patients to have been cognitively lucid prior to surgery. Weight status of 58% of the patients was normal (BMI 18.5-24.9), 24% were overweight (BMI 25.0-29.9), and 9% were obese (BMI 30.0 and above).

The patients’ ADL functions were significantly impaired at four months compared to the preoperative situation, and their need for social support and assistance had increased respectively.

Thirty-nine percent of the fractures occurred at home and 38% in a hospital, and significantly more fractures occurred during the daytime than at night.
Only two patients (1%) underwent surgery under general anaesthesia, while the remaining operations were performed in spinal or epidural anaesthesia. Low molecular weight heparin was used in every case for thromboembolic prophylaxis, and antibiotic prophylaxis was used in 92% of cases.

The most common complications were urinary tract (21%) and pulmonary infections (7%). The deep wound infection rate was 2.5%.

5.5 Suitability of short four-month follow-up in studies of hip fracture treatment and rehabilitation

All the patients who returned to their own homes did so by four months. The patients' walking abilities were significantly restored at the population level within four months, but the changes in individual cases were not always positive. Ninety-one out of 152 patients (59%) retained the level of walking ability achieved at four months up to one year; 40 patients (26%) improved their walking ability, and the walking ability of 21 patients (14%) deteriorated. The use of walking aids did not decrease significantly after four months. The proportion of painless patients increased significantly from four months to one year.

Of the ADL functions, the abilities to dress, eat and cook improved, and the need for special transportation services declined marginally but statistically significantly after four months of follow-up, but the abilities to bathe, shop, do laundry and manage toileting, household chores and money matters remained unchanged.
6 Discussion

6.1 Functional outcome after HA and OS in the treatment of cervical hip fractures especially in view of different age groups

The study patients were obtained from two different hospitals and countries. There may be differences in treatment, staff educational background and resources, rehabilitation routines and resources. Very detailed data of this kind were out of reach for us. It is possible that these factors are reflected in our results and cause biases. However, Sweden and Finland are very similar as to climate, housing conditions, culture, demographics and welfare facilities. Both of the participating hospitals are university hospitals with similar catchment populations, and both are very familiar with their respective treatments and have long-lasting traditions of their use. Hence, we consider a matched comparison of this kind justifiable and capable of providing reliable information.

In view of the lower mortality, OS seemed to be the recommendable treatment method for patients aged 55-75 years at one-year follow-up, but this age group had a higher reoperation rate than any other group. This is in line with the conclusion of Johnson and Crothers (1975) that OS is indicated for younger patients who are willing to gamble on the 60/40 chance of excellence over failure and can be expected to tolerate a second procedure in the event of failure.

For the age group of 76-80 years, OS seems to be a better treatment in terms of mortality, pain and use of walking aids. This is in agreement with the study of van Vugt et al. (1993), reporting that osteosynthesis gives better results than HA in patients aged 71-80 years with displaced intracapsular hip fractures and in good physical and mental condition. Similarly, Kuokkanen et al. (1990) recommended HA only to patients with a short life expectancy because, 10 years after the HA operation, only 22% of patients were satisfactory according to the Harris hip score.

The Scottish national guideline for hip fracture treatment, which is based on a systematic literature review, recommends that most of the undisplaced cervical fractures should be treated surgically with OS, except in the very elderly, for whom HA may be considered (Prevention and management of hip fracture in older people. A national
clinical guideline 2002). For displaced cervical fractures, it suggests using OS for younger, active and fit patients and HA for patients with an anticipated survival of less than three years and whose activity level is low. For all other patient groups, it suggests the use of either OS, HA or THA. This is in agreement with our results.

Most of the earlier studies have shown that the mortality associated with OS is lower compared to HA, as was also the case in our study (Hunter 1969, Hunter 1974, Sikorski & Barrington 1981, Skinner et al. 1989, van Vugt et al. 1993, Hui et al. 1994, Berglund-Rödén et al. 1994). Two randomised trials have also confirmed this (Parker & Pryor 2000, Davison et al. 2001), while one randomised trial found no difference in mortality between these two methods (Parker et al. 2002a). Furthermore, patients with OS have less pain than those with HA, as also reported earlier (Skinner et al. 1989, Berglund-Rödén et al. 1994, Hui et al. 1994). This allows early and more intensive mobilisation, which prevents complications.

Reoperation rate has been reported to be higher after OS than after HA in most earlier studies (Hunter 1974, Rodriguez et al. 1987, Skinner et al. 1989, van Vugt et al. 1993, Hui et al. 1994, Parker & Pryor 2000, Davison et al. 2001, Parker et al. 2002a). We found no difference in reoperation rate at four months, but OS involved a higher reoperation rate at one year. It is highly probable that, if our follow-up had been longer, there would have been more reoperations especially in HA group, as there have been in previous studies (Ravikumar & Marsh 2000). This must be considered in active and young patients with anticipated survival of several years (Prevention and management of hip fracture in older people. A national clinical guideline 2002).

We here compared LIH OS to Austin Moore HA. There are several other OS methods available, as it has been said that cervical hip fracture is probably the fracture for which there exists the largest number of OS methods (Strömqvist et al. 1983). Anyhow, LIH OS has been found to be comparable to other OS methods in terms of complications, reoperations, functional outcome and mortality (Sernbo et al. 1990, Herngren et al. 1992, Elmerson et al. 1995, Lykke et al. 2003). There are also numerous different HAs available. Austin Moore is an old prosthesis but still widely in use (Parker 2003a). Uncemented Austin Moore has been found to involve more periprosthetic fractures (Foster et al. 2005), revisions (Graves 2005), postoperative pain and need for walking aids (Emery et al. 1991) than cemented Thompson prosthesis. There are no comparisons to newer prostheses available and hence no evidence yet of possibly better results than those obtainable with Austin Moore HA.

6.2 Hip fracture treatment and outcomes in Finland and Great Britain

This comparison was possible because both centres had undertaken a full audit of the outcomes of all patients. For any comparison to be valid, it is essential to have a consecutive series of patients with identical inclusion and exclusion criteria and identical outcome measures. In addition, a sufficient number of cases are required, as in this study.

The populations of hip fracture patients in the two centres were similar but not identical, the patients in Peterborough being an average of two years older and having a
lower male-to-female ratio. In Oulu, fewer patients were living at their own homes, but of those living at home, a greater number were living alone. We consider this a cultural difference. Of the background factors, the use of walking aids is strongly influenced by culture and climate. For example, Finnish municipalities provide walking aids free of charge for their inhabitants. Walking ability, especially the patient’s ability or inability to walk alone outdoors, is the most reliable variable in the evaluation of patients’ functioning, as we think it is least influenced by the differences between the countries. It turned out that the patients with cervical fracture had had slightly poorer functional capacity at the time of the fracture in Peterborough compared to Oulu. In addition, some of the differences in the distribution of the sub-categories of fracture types may be explained by errors in the classification process.

In Oulu, half of the operations were performed by trainee surgeons on a training scheme and only one fifth by qualified orthopaedists. In Peterborough, there was a hip fracture project going on, in which hip fracture patients are managed by a specialised team, and, whenever possible, surgery is performed by one surgeon and early discharge of patients is encouraged (Parker et al. 1991, Parker et al. 2000).

Some differences were apparent in the choice of the surgical treatment. In Oulu, hemiarthroplasty is the primary mode of treatment for cervical fractures, at least for the oldest patients, as it is in almost every hospital in Finland. Osteosynthesis is only used for younger patients with fairly good pre-fracture ambulatory capacity. Total hip replacement is performed on patients with arthritis of the hip or rheumatoid arthritis. Gamma nail is the primary fixation method for trochanteric fractures, and the sliding hip screw is used as an alternative when preferred by the surgeon. In Peterborough, Austin Moore hemiarthroplasty was also used extensively for intracapsular fractures, but a greater proportion of displaced cervical fractures in the elderly were treated by internal fixation as part of an ongoing randomised trial comparing internal fixation with arthroplasty (Parker & Pryor 2000). The higher revision rate in this group of patients for osteosynthesis accounts for the higher revision rate after internal fixation in Peterborough. The lower re-operation rate for hemiarthroplasty in Peterborough may be explained by the routine use of the anterior surgical approach, whereas in Oulu the posterior approach was used, and the main reason for re-operation in Oulu was dislocation of the prosthesis. The other reasons for the lower overall re-operation rate in Peterborough include the use of a specialised surgeon to perform or supervise the majority of the surgical procedures (Parker et al. 1994, Parker & Pryor 2000).

The main difference between the two centres was the mode of discharge following surgery. In Oulu, hip fracture patients were routinely discharged from the orthopaedic ward into health care centre hospitals or rehabilitation units as soon as the patient’s general medical condition allowed it. Therefore, the percentage of patients returning to their original place of residence was low. As it has been noted earlier by Jalovaara et al. (1992), when, in the group of patients originally coming from their own homes, the mean hospitalisation time in the orthopaedic ward was related to the percentage of patients discharged directly to their own homes, an almost linear relationship was found. In Peterborough, patients were generally kept in the admission unit in the orthopaedic ward till discharge into their own homes or their original places of residence. This is reflected in the outcomes at 120 days, with a greater proportion of patients being back at their own
homes in Peterborough. This difference may also reflect the availability of institutional care in these centres. Cost of care was not studied.

Such standardised audits comparing different countries yield unique information of the quality of treatment. A comparison of outcome figures from different studies can create an illusion of quality (Parker et al. 2002b). Audit participants have paid attention to their treatment policies and acquired information of their actual treatment protocols and outcomes (Todd et al. 1995). This information has affected the methods of treatment used and increased the use of evidence-based methods (Todd et al. 1995, Cserháti et al. 2002). The SAHFE core data set is a very useful, easy-to-use and well tested audit tool for this purpose. It is recommendable for all centres treating hip fractures to participate in such an audit.

6.3 Hip fracture treatment and functional outcomes in six hospitals in Finland

Initially, we found no differences in unadjusted mortality between the centres, but when the background factors were considered, minor differences emerged. Moreover, there were differences between the centres in the unadjusted postoperative place of residence, but after risk adjustment, the differences turned out to be statistically non-significant. Therefore, a comparison between medical centres with regard to the treatment of hip fractures requires risk adjustment (Todd et al. 1995, Mozes et al. 1999, Freeman et al. 2002, Parker et al. 2002b).

It has been shown that good hospital performance on one outcome is not necessarily related to good performance on another when treating hip fractures (Mozes et al. 1999, Hannan et al. 2001). Here, too, one of the participating hospitals had a low risk-adjusted mortality rate but less good outcomes in risk-adjusted mobility. In addition, another hospital had good results in risk-adjusted mobility but a higher risk-adjusted mortality rate. This emphasizes the importance of multidimensional evaluation (Mozes et al. 1999, Hannan et al. 2001, Parker et al. 2002b).

We did not find any major differences in outcomes between the hospitals. This shows that the quality of care is quite similar in them. In this respect, the results were approximately as anticipated. Still, there were minor but statistically significant differences in adjusted postoperative mobility and mortality. No single factor or aspect of practice that would explain these differences could be pointed out, and there are many explanations for the differences in hospital performance. It is possible that our models did not fully adjust for the differences in the patients’ background factors, i.e. there may have been some important risk factors that went unrecorded. This is not probable, however, as we used many variables shown earlier to be predictive of functional outcome and mortality after hip fracture, such as age, sex, preoperative place of residence, mobility and morbidity (Berglund-Röden et al. 1994, Todd et al. 1995, Mozes et al. 1999, Hannan et al. 2001, Cserháti et al. 2002, Freeman et al. 2002, Parker et al. 2002b). Therefore, we believe that the differences in outcome observed here reflect real variation in the quality of care between the hospitals and are, doubtless, due to the cumulative effects of several aspects of the treatment and management of hip fractures, as also noted by Todd et al.
However, these differences may facilitate the further development of treatment in the units involved. It should be emphasized that our results are affected by the quality of care of the whole treatment chain, including the rehabilitation units, health centre hospitals, convalescent homes and geriatric departments, rather than merely by the quality of the primary hospitals. However, this bias is potentially present in any long-term outcome study on trauma patients.

The biggest difference in treatment was seen in the surgical methods applied to trochanteric fractures. Two hospitals used almost exclusively SHS, while one preferred Gamma nail. This difference was not reflected in the results according to multivariate analysis, indicating that these methods are fairly equal with regard to functional outcome.

According to this audit, the treatments given in these Finnish hospitals lead to very similar results. There were minor differences, but their causes could not be identified. More detailed information on treatment could have shed light on this matter. This information could have been obtained by the SAHFE extended data set. Moreover, after these results and even because of these minor differences, the participating hospitals are likely to be willing to enhance their treatment protocols and later to review their results. This will lead to continuous audit cycles, which would be best carried out by establishing hip fracture registers, which has been done in Sweden (Thorngren 1991).

6.4 SAHFE (Standardised Audit for Hip Fractures in Europe) extended data collection set and its suitability to studies of hip fractures

The questionnaires excluding follow-up inquiry were filled in by the research nurse. Their completion took an average of 1 to 1½ hours. Very often, the patient was not able to answer all the questions because of memory failure or dementia. In these cases, the nurse contacted the patients’ relatives or the staff of the relevant institution to obtain the lacking information. Despite that, some data still remained missing.

The abbreviated mental test and the questions concerning psychological status were applied either prior to surgery or afterwards, when the patient’s medical condition had stabilized. The mental test was not administered to the patients at four months, because the patients themselves filled in the four-month forms and the test requires an examiner.

The answers to the questions on ADL and social support and assistance were, in most cases, obtained from the patients themselves, but quite often also from the patients’ family members or the staff of the patients’ service blocks, old people’s homes, etc. Health status, laboratory values (blood haemoglobin, serum creatinine and albumin) and information on the surgery were easily obtained from patient records, and only a few data were missing concerning these. The dates of menarche and menopause could not be found in the patient files. Many female patients were unable to reliably remember these data, and a considerable number of dates are therefore missing. Details of the injury were reliably obtained from the patients in most cases.
An orthopaedic surgeon completed the inquiries concerning different fracture classifications. Their simultaneous use is only indicated in special studies focusing on very detailed problems. There were some problems in the availability of roentgenograms for classification because they were reserved by the treatment staff.

Detailed information on complications provides notable added value to the results. It is likely, however, that some complications are missing because this form was only filled in the case of complications, not routinely for all patients. In such mode of action, underreporting is very likely.

In the literature, there are no such data collection sets similar to ours, and no comparisons can therefore be made. But the measurements used here have also been used in other studies. This ensures their credibility. The SAHFE extended data set is usable in studies on hip fractures or as a part of a larger hip fracture register.

### 6.5 Suitability of four-month follow-up in studies of hip fracture treatment and rehabilitation

Previous findings indicate that most of the recovery of the patients’ functions takes place by four to six months. Magaziner et al. (1990) observed only slight additional recovery in a few functional domains at the population level between six and twelve months, while most recovery took place by six months. In a later study, he noted that recuperation times were specific to the area of function, ranging from approximately four months for depressive symptoms, upper extremity function and cognition to almost a year for lower extremity function (Magaziner et al. 2000). Ceder et al. (1980) found that the proportion of patients living at their own homes and managing their basic ADL or household functions did not markedly increase between four months and twelve months after the fracture. In the study of Koval et al. (1998), 84% of patients, who were home-dwelling before the fracture, had been independent in all basic activities of daily living before their hip fracture. The proportion of patients who recovered to the baseline level increased notably between three and six months but only marginally between six and twelve months. Borgquist et al. (1990) concluded that ADL, walking ability and household activities remained at the level already achieved within four months after the fracture during the ten-year period for which they prospectively followed up patients admitted from their own homes. Our data also suggest that most of the recovery after a hip fracture occurs during the first four months.

The changes noted in patients’ residential status after four months in the previous studies are not systematic. Ceder et al. (1980) and Kitamura et al. (1998) found that the proportion of patients living at their own homes increased slightly but insignificantly between four months and one year. On the other hand, in the studies of Holmberg et al. (1986), Keene et al. (1993) and Thorngren et al. (1993), the proportion of patients living at their own homes decreased somewhat between four months and one year. Our finding of a 3% decrease is in agreement with the latter reports. Thus, it can be concluded that four months seems to be a sufficient follow-up time for residential status as a functional outcome variable.
Comparison of the changes in walking ability between four and twelve months with the previous studies is difficult due to the variation in scoring methods and follow-up points. However, walking ability seems to improve slightly in most reports (Borgquist et al. 1990, Magaziner et al. 1990, Kitamura et al. 1998, Magaziner et al. 2000), as it also did in this study. After all, it seems that the majority of patients recover their pre-fracture walking ability within four to six months following the surgery.

In our study, the patients surviving for one year regained four out of ten ADL functions between four months and one year. Ceder et al. (1980) found no remarkable changes in ADL functions between four and twelve month. Koval et al. (1998) reported that 59% of patients had recovered to their pre-fracture level of basic ADL at three months, 71% at six and 73% at twelve months. Their respective percentages for instrumental ADLs were 53%, 42% and 48%. Magaziner et al. (1990) noted an increase in the proportion of patients who attained their pre-fracture level of functioning between two and six months following discharge in most tasks. Later, between six and twelve months, no change was observed in any task. In his later study, recuperation times were 4.3 months for upper extremity physical ADLs and 11 months for lower extremity physical and instrumental ADLs (Magaziner et al. 2000). However, most recovery appeared to take place during the first six months, with only minor gain observed thereafter. According to Borgquist et al. (1990), ADL functions remained fairly stable from four months postoperatively to up to ten year. This was also noted by Nurmi et al. (2004): there was no statistically significant difference in patients’ functional capacity (sum of nine individual variables) between four and twelve months. Thus, it seems that most ADL abilities are regained within four to six months, and that only minor further improvement may occur hereafter, which is in agreement with our results.

It is notable that even one-year follow-up cannot reveal all possible late surgical complications, some of which may occur several years after the primary treatment. In the treatment of cervical hip fractures with OS, late complications have been reported to occur more than two years after the primary treatment (Strömqvist et al. 1992). Respectively, for HA, the latest surgical complications may occur decades after the operation (Ravikumar & Marsh 2000). Thus, in view of surgical complications and reoperations, follow-up should be lifelong.

It is noteworthy that, in most of the previous studies using several checkpoints, the results have been given as fractions of surviving patients at each follow-up point. Only Koval et al. (1998), Magaziner et al. (1990, 2000) and Nurmi et al. (2004) seem to have evaluated at each checkpoint the function of only those patients who were alive at the end of the study, as done here. We observed that the patients who died between four and twelve months were among those with the poorest functional capacity in the four-month evaluation. If this fact is overlooked, it may seem that the functional capacity of the patient population improves markedly over time. Therefore, attention should be paid to the use of an adequate statistical method, i.e. analysis of repeated measures, which excludes data on patients not alive at the last follow-up, and accurate reporting methods used.

Finally, according to our findings, four-month follow-up was justified as the shortest reliable follow-up time, as 6 of the 10 ADL variables and residential status did not change after that. However, based on the literature, it is probable that some functional aspects do change slightly even after that, and one-year follow-up seems to be more reliable when
several outcome measurements are used. But after that, notable data will be lost due to the fact that 25 to 30% of patients die during the first year. Thus, a long follow-up for several years without short-term checkpoints may fail to recognise the quality of life and restored function achieved shortly after the fracture, which are of vital importance for these old and frail patients with a short life expectancy.
7 Conclusions

1. LIH OS was associated with better functional outcome and lower mortality at the expense of a higher reoperation rate than Austin Moore HA, especially in patients aged under 80 years.
2. The characteristics of hip fracture patients and their outcomes in terms of mortality are rather similar in Finland and Great Britain.
3. There are minor but statistically significant differences in postoperative mobility and mortality of hip fracture patients between the six Finnish hospitals, but no single factor or aspect of practice could be found that would explain these differences.
4. The extended SAHFE data set is a practical tool for detailed investigations of the background factors and outcome after hip fractures in a standardised manner.
5. Four-month follow-up is justified as the shortest feasible alternative in studies on rehabilitation and residential status after hip fractures.
References


Sund R. Simultaneous impact of sex, age, institutionalisation, urbanity, seasonality, and year on the hip fracture incidence. Inj Prev (in press).


Appendix I

Following are the patient registration forms used in studies I and II.
1. ___ FORM

2. ____________ HOSPITAL CODE
   (or NAME of hospital)

3. ___ OPERATING DEPARTMENT, 1. orthopedic, 2. general surgery, 3. other

4. ____________ DATE OF BIRTH-SOCIAL SECURITY NUMBER; the first six
digits show year, month and day.

5. ___________________________ NAME OF PATIENT

6. ___ SEX 1 = male, 2 = female.

7. ____________ DATE OF ADMISSION (year, month, day)

8. ____________ DATE OF OPERATION (year, month, day)

9. ____________ DATE OF DISCHARGE (year, month, day)

10. ___ ADMITTED FROM: 1. own home
     2. convalescent home
     3. fullservice unit with meals,
     4. geriatric department, rehabilitation clinic
     5. long-term care institution, nursing home
     6. acute hospital
     7. other
     8. not admitted, taken care
        home for the elderly
     9. unknown

11. ___ DISCHARGED TO: 3. fullservice unit with meals,
     4. geriatric department, rehabilitation clinic
     5. long-term care institution, nursing home
     6. subacute center

12. ___ MARITAL STATUS AT PRESENT: 1. not married, 2. married, 3. divorced, 4. widow/widower

13. ___ LIVED ALONE AT THE TIME OF FRACTURE: 1 = yes, 2 = no.

14. ___ HOME HELP AT THE TIME OF FRACTURE: Number of hours/week (none = 0)

15. ___ TYPE OF FRACTURE 1. undisplaced cervical (Garden I-II)
     2. displaced cervical (Garden III-IV)
     3. bascervical
     4. trochanteric twofragment fracture
     5. trochanteric multiframe fragment fracture
     6. subtrochanteric

16. ___ PRIMARY OPERATION (method of operation, for alt. see the back of the form)

17. ___ REOPERATIONS DURING THE PRIMARY ADMISSION PERIOD: 1 = yes, 2 = no (Note that if “yes”
the reoperation form 3 should be completed)

18. ___ GENERAL LOCOMOTOR ABILITY BEFORE THE FRACTURE:
     1. could walk alone indoors
     2. could walk alone out of doors only accompanied
     3. could walk alone indoors but not out of doors
     4. could walk indoors only accompanied

Which WALKING AIDS did the patient use indoors?

19. ___ BEFORE THE FRACTURE
     1. can walk without aids
     2. one stick (crutch or tripod, hemiwalker)
     3. two sticks
     4. one stick + one tripod
     5. two tripods
     6. rollator/walking-frame
     7. wheelchair
     8. does not walk

20. ___ 2 WEEKS AFTER THE OPERATION
     (or at discharge if earlier than 2 weeks)
     1. can walk without aids
     2. one stick (crutch or tripod, hemiwalker)
     3. two sticks
     4. one stick + one tripod
     5. two tripods
     6. rollator/walking-frame
     7. wheelchair
     8. does not walk

21. ___ Could the patient DRESS-UNDRESS (ADL) before the fracture. 1 = yes, 2 = no

22. ___ Could the patient manage ADL two weeks after the operation (or at discharge if earlier than two
     weeks) 1 = yes 2 = no

23. ___ DEAD in hospital. 1 = yes (date should be given in item 10 above), 2 = no

24. ___ IV

25. ___ II

26. ___ III

27. ___ IV

28. ___ V

29. ___ VI

(Items 25-30 permit the department to enter parameters of their own choice)

The form completed by __________________________ position __________________________ telephone: __________________________
The hospital is identified by the code number designated by the State Medical Board.

**Operation-methods:**

1. von Bahr
2. Two screws, type
3. Three or more screws, type
4. LIH-Lars Ingvar Hansson pins
5. Rydell three flanged nail
6. Other flanged nail, type
7. Multiple pins, type
8. Telescoping screw + plate, type
9. Telescoping nail + plate, type
10. Fixed nail-plate, type
11. Endernail
12. AO-plate
13. Other osteosynthesis, type
14. Hemiarthroplasty, type
15. Total hip arthroplasty, type
16. Not operated
17. Other type

Note that appliance of traction is not coded!

This multicenter study has been initiated by the Swedish Orthopedic Society and is supported by the Swedish Medical Research Council.
TO THE PATIENT

(Or to the district nurse, physiotherapist, physician or similar personnel at servicehome, convalescent home, nursing home etc).

You have been operated for a hip fracture on ________________ side. Four months after the operation (date: ________________) we wish you to complete this form and return it to the following address: _______________________________________.

______________________________________________________________________________

______________________________________________________________________________ (name of the hospital where operated).

When you complete the form encircle the digit or letter for the alternative which makes up your answer.

Do not forget to give all the dates and locations you have been at since discharge from the department where you were operated (question 9).

This form will be the basis for further treatment of your hip fracture if necessary. The forms will also be used for statistical analysis without identification of individual patients.

This survey has been initiated by the Swedish Orthopedic Society and is supported by the Swedish Medical Research Council.

TO THE WARD

Complete questions 1–6 before the form is given to the patient. Instruct the patient before discharge how he/she should complete the form and return it to your department.
HIP FRACTURE

1. __ 2. __ FORM

2. __________ HOSPITAL CODE

3. ____________ PATIENT IDENTIFICATION (DATE OF BIRTH) (year, month, day)

4. ___________ NAME

5. __ SIDE OF FRACTURE  1 = left,  2 = right.

6. __ FRACTURE TYPE  Use the code noted in question 16 in the yellow form

7. __ WHERE DO YOU LIVE NOW, 4 months after your hip fracture?
   (encircle one of the following alternatives)
   1. own home    5. long-term care institution,
   2. convalescent home    nursing home
   3. fullservice unit with meals,    6. acute hospital
      home for the elderly
   4. geriatric department,
      rehabilitation clinic
   7. other
   8. unknown

8. __ WHERE DID YOU LIVE AT THE TIME OF YOUR HIP FRACTURE?
   (Alternatives as above – write digit in this square __)

9. We are interested to know where you have stayed after you were discharged from the hospital where you were operated. Please describe below where you have been (even new hospital admissions), including the dates and number of days for these periods. Describe all the places you have moved to (if there are not enough space below, use the back of this form).

   TYPE OF STAY                   DATES                   NUMBER OF DAYS
   (alternatives as for question 7).

   __________   __________   __________

   __________   __________   __________

   __________   __________   __________

   __________   __________   __________

10. __________  
11. __________  
12. __________  
13. __________  
14. __________  
15. __________  
16. __________  
17. __________  
18. __________  

HIP FRACTURE

CONTINUOUS OF FORM 2

19. □ DO YOU LIVE ALONE NOW?   1 = yes, 2 = no

20. □ Which WALKING AIDS do you use indoors now?
   1. can walk without aids  5. two tripods
   2. one stick (crutch or tripod, hemiwalker).
   3. two sticks  8. does not walk
   4. one stick + one tripod  7. wheelchair

21. □ DO YOU HAVE PAIN WHEN YOU PUT WEIGHT ON THE OPERATED EXTREMITY?
   1. Yes, quite a lot
   2. Yes, a little
   3. No, not at all

22. □ HAVE YOU TAKEN ANALGESICS SEVERAL DAYS DURING THE LAST WEEK BECAUSE OF PAIN FROM YOUR HIP?  1 = yes, 2 = no

23. □ HOW GOOD IS YOUR WALKING ABILITY? (choose what best applies to you)
   1. can walk alone out of doors  4. can walk indoors only accompanied
   2. can walk out of doors only accompanied  5. can not walk but is sitting in a chair
   3. can walk alone indoors but not out of doors  6. always bedridden
   9. unknown

24. □ DO YOU WALK EQUALLY WELL NOW AS BEFORE THE FRACTURE?
   1. yes
   2. no, the fractured hip gives me problems
   3. no, for other reasons

25. □ CAN YOU DRESS – UNDRess YOURSELF?  1 = yes, 2 = no

26. □ HOW MANY HOURS PER WEEK DO YOU HAVE HOMEHELP
   ____________________ hours per week (No homehelp = 0).

27. □ A (Do not fill in this)

28. □ B (Do not fill in this)

The form completed by ________________________________

______________________________

Telephone: ________________________________

Thank you for your help!
MULTICENTER
HIP FRACTURE
STUDY
co-ordinator prof. K-G Thorngren
Lund University Hospital
S-221 85 LUND, SWEDEN

1. FORM

2. HOSPITAL CODE (or NAME of hospital )

3. OPERATING DEPARTMENT, 1. orthopedic, 2. general surgery, 3. other

4. DATE OF BIRTH-SOCIAL SECURITY NUMBER; the first six digits show year, month and day

5. NAME OF PATIENT

6. SIDE OF FRACTURE 1 = left, 2 = right

7. SEX 1 = male, 2 = female

8. DATE OF ADMISSION (year, month, day)

9. DATE OF OPERATION (year, month, day)

10. DATE OF DISCHARGE (year, month, day)

11. ADMITTED FROM:

1. own home
2. convalescent home
3. fullservice unit with meals, home for the elderly
4. geriatric department, rehabilitation clinic
5. long-term care institution, nursing home
6. acute hospital
7. other
8. not admitted, taken care of in another department (which )
9. unknown

12. DISCHARGED TO:

13. RE-OPERATION

1. extraction of osteosynthesis only
2. hemiarthroplasty (type )
3. total hip arthroplasty (type )
4. re-osteosynthesis (revision with internal fixation)
5. Girdlestone
6. other

14. REASON FOR RE-OPERATION

1. fracture displacement
2. non-union (pseudarthrosis)
3. femoral head necrosis (segmental collapse)
4. loss of position of osteosynthesis material without fracture displacement
5. local tenderness over the osteosynthesis material (the fracture is united)
6. infection
7. refraction
8. other

Which WALKING AIDS did the patient use indoors?

15. IMMEDIATELY BEFORE THE RE-OPERATION

1. can walk without aids
2. one stick (crutch or tripod, hemiwalker)
3. two sticks

16. 2 WEEKS AFTER THE RE-OPERATION

1. one stick + one tripod
2. two tripods
3. roller/walking frame
4. wheelchair
5. does not walk

17. DEAD in hospital 1 = yes (date should be given in item 10 above), 2 = no

18. I 19. II 20. III

21. IV 22. V 23. VI

(items 18-23 permit the department to enter parameters of their own choice)

The form completed by position telephone:
Appendix II

Following are the SAHFE hip fracture patient registration forms used in studies III-V.
1. Country and hospital code
   First 3 numbers are the countries international dialling code, then 6 numbers for the hospital code.

2. Patient ID number
   Each hospital may choose their own ID number, e.g. social security number, hospital record number.
   Even if the patient is admitted later for a second fracture the same number is used.

3. SAHFE number (Computer generated when form 1 is registered).

4. Side of fracture
   1—Left 2—Right (If simultaneous bilateral fracture, use 2 forms.)

5. Date of fracture (If not known, use “Date of admission”, form 1.)

6. Date of birth (e.g. 25/06/1945)

7. Sex 1—Male 2—Female

8. Date of admission

9. Admitted from
   Choose the one option that best applies. For full explanation see on the back of this form.
   1—Own home 2—Sheltered housing 3—Institutional care 4—Nursing home
   5—Permanent hospital inpatient 6—Rehabilitation unit 7—Acute hospital 8—Other 9—Died

10. Living alone (A modification to this is available in the optional section)
    1.0—Yes 2.0—No 3.0—Institutional care (categories 3-7 above)

11. Walking
    Refers to the patient’s normal walking ability immediately before the fracture occurred.
    1—Walked alone out of doors 2—Walked out of doors only if accompanied
    3—Walked alone indoors but not out of doors 4—Walked indoors only if accompanied 5—Unable to walk

12. Walking aids
    Refers to the walking aids normally used before the fracture occurred.
    1—Can walk without aids 2—One aid (stick, crutch, tripod or hemiwalker)
    3—Two aids (stick, crutch, tripod or hemiwalker) 4—Frame (walking frame or rollator) 5—Wheelchair/bedbound

13. ASA grade
    1—Completely fit and healthy, 2—Some illness but this has no effect on normal daily activity, that is an asymptomatic condition such as hypertension, 3—Symptomatic illness present, but minimal restriction on life, e.g. mild diabetes mellitus, 4—Symptomatic illness causing severe restriction, e.g. severe chronic bronchitis, unstable diabetes, 5—Moribund

14. Type of fracture (see figure on the back of this form)
    Choose the area of bone in which the main fracture line crossing femur is predominately found.
    1—Undisplaced intracapsular 2—Displaced intracapsular 3—Basocervical
    4—Trochanteric two fragments 5—Trochanteric multi-fragments 6—Subtrochanteric (any number of fragments)

15. Pathological fracture
    1—No 2—Malignant secondary bone tumor 3—Malignant primary bone tumor
    4—Bone cyst 5—Paget’s disease 6—Other (specify)

16. Date of operation
    Leave blank only if not operated on.

17. Primary operation
    (A modification to this is available in the optional section)
    1—Single screw, pin or nail 2—Two screws, pins or nails 3—Three or more screws, pins or nails
    4—Single screw, pin or nail with side plate 5—Intramedullary nail 6—Hemiarthroplasty
    7—Total hip arthroplasty 8—Conservative 9—Other (specify)

18. Date of discharge or death from primary admission ward
    Has any re-operation been performed? If yes, complete form 5 (questions 28-34) for each re-operation

19. Discharged to (code as question 9)
Codes for "Admitted from"

1 = Own home. Independent living accommodation although the person may receive assistance from relatives and outside agencies at home. Own, rented house, family member’s home.
2 = Sheltered housing, warden controlled accommodation, special flat. Partly independent living accommodation where major assistance is given.
3 = Institutional care. Long term/permanent placement in a full service residential home, home for the elderly or infirm where meals are provided but the patient is mobile and generally able to carry out basic activities of daily living (dressing, washing, feeding toileting). A social provision with minimum nursing input.
4 = Nursing home. Long term/permanent placement in an institutional home which has provision of nursing facilities to provide assistance in the basic activities of daily living of dressing, washing and toileting.
5 = Permanent hospital inpatient. Long term/permanent placement of a patient in hospital which has nursing and medical support and for which there are no plans for discharge.
6 = Rehabilitation unit. Short term/temporary placement in either a community rehabilitation unit, temporary nursing care, geriatric assessment unit, respite care, convalescent home.
7 = Acute hospital. Short term/temporary placement.
8 = Other (specify)
9 = Died (only applies when answering question 19, 34)

Codes for "Type of fracture"

1 = Undisplaced intracapsular (subcapital or cervical). Garden grade 1 or 2
2 = Displaced intracapsular (subcapital or cervical). Garden grade 3 or 4
3 = Basocervical (basal)
4 = Trochanteric two fragments (a two part fracture, stable fracture) Trochanteric fractures are also termed intertrochanteric or pertrochanteric fractures.
5 = Trochanteric multi-fragments (the extra fragments are generally the greater or lesser trochanter or both)
6 = Subtrochanteric (any number of fragments)
1. Country and hospital code
   First 3 numbers are the countries international dialling code, then 6 numbers for the hospital code.

2. Patient ID number
   Each hospital may choose their own ID number, e.g. social security number, hospital record number.
   Even if the patient is admitted later for a second fracture the same number is used.

3. SAHFE number (Computer generated when form 1 is registered).

4. Side of fracture 1=Left 2=Right (If simultaneous bilateral fracture, use 2 forms.)

5. Date of fracture (If not known, use 'Date of admission', form 1.)

6. Date of birth (e.g. 25/06/1945)

7. Sex 1=Male 2=Female

8. Date of assessment

9. Assessment done by
   1=Face to face interview with patient 2=Face to face interview with carer/relative/friend
   3=Phone to patient 4=Phone to carer/relative/friend
   5=Postal questionnaire completed by patient 6=Postal questionnaire completed by carer/relative/friend
   7=Other (specify)

10. Residential status
    Choose the one option that best applies. For full explanation see on the back of this form.
    1=Own home 2=Sheltered housing 3=Institutional care 4=Nursing home
    5=Permanent hospital inpatient 6=Rehabilitation unit 7=Acute hospital 8=Other
    9=Died

11. Locomotor ability
    Refers to the patients normal walking ability at 4 months after the fracture occurred.
    1=Walks alone outdoors 2=Walks outdoors only if accompanied
    3=Walks alone indoors but not outdoors 4=Walks indoors only if accompanied
    5=Unable to walk

12. Walking aids
    Refers to the walking aids normally used at 4 months after the fracture occurred.
    1=Walks without aids 2=One aid (stick, crutch, tripod or hemiwalker)
    3=Two aids (stick, crutch, tripod or hemiwalker) 4=Frame (walking frame or rollator)
    5=Wheelchair/bedbound

13. Pain at the hip (choose the one most relevant option)
    1=The pain in my hip is severe and spontaneous. I experience it even when I am not moving.
    2=The pain in my hip is severe when I attempt to walk and prevents all activity.
    3=The pain in my hip is tolerable, permitting limited activity.
    4=The pain in my hip occurs only after some activity and disappears quickly with rest.
    5=The pain in my hip is slight or intermittent. I experience pain when starting to walk but the pain gets less with normal activity.
    6=I experience no pain in my hip.
    7=Unable to answer.

14. Type of stay/re-admissions
    For type of stay, use options in question 9 (see the back of this form). For days, give number of days stay at each residential category from the time of discharge from primary admission up to 120 from fracture. For reason, use the following codes.
    1=Surgical complications requiring re-operation (answers questions 28-34 have been completed for each re-operation).
    2=Surgical complications not requiring re-operation.
    3=Medical complications related to hip fracture.
    4=Failure to manage at place of origin due to hip fracture.
    5=Admitted for reasons not related to hip fracture.
    6=Return to place of origin
    7=Unknown/not stated

15. Death (If death within 4 month of fracture give date of death.)
Codes for "Residential status"

1: Own home. Independent living accommodation although the person may receive assistance from relatives and outside agencies at home. Own, rented house, family member’s home.

2: Sheltered housing, warden controlled accommodation, special flat. Partly independent living accommodation where major assistance is given.

3: Institutional care. Long term/permanent placement in a full service residential home, home for the elderly or infirm where meals are provided but the patient is mobile and generally able to carry out basic activities of daily living (dressing, washing, feeding toileting). A social provision with minimum nursing input.

4: Nursing home. Long term/permanent placement in an institutional home which has provision of nursing facilities to provide assistance in the basic activities of daily living of dressing, washing and toileting.

5: Permanent hospital inpatient. Long term/permanent placement of a patient in hospital which has nursing and medical support and for which there are no plans for discharge.

6: Rehabilitation unit. Short term/temporary placement in either a community rehabilitation unit, temporary nursing care, geriatric assessment unit, respite care, convalescent home.

7: Acute hospital. Short term/temporary placement.

8: Other (specify)

9: Died (only applies when answering question 19, 34)
Re-operation—form 3

Audit of Hip Fractures in Europe

1. Country and hospital code
   First 3 numbers are the country international dialling code, then 6 numbers for the hospital code.

2. Patient ID number
   Each hospital may choose their own ID number, e.g. social security number, hospital record number.
   Even if the patient is admitted later for a second fracture the same number is used.

3. SAHFE number (Computer generated when form 1 is registered).

4. Side of fracture 1=Left 2=Right (If simultaneous bilateral fracture, use 2 forms.)

5. Date of fracture (If not known, use “Date of admission”, form 1.)

6. Date of birth (e.g. 25/06/1945)

7. Sex 1=Male 2=Female

28. Date of admission
   If already in hospital and not discharged since primary admission use same date as question 8

29. Admitted from
   Choose the one option that best applies. For full explanation see on the back of this form.
   1=Own home 2=Sheltered housing 3=Institutional care 4=Nursing home 5=Permanent hospital inpatient
   6=Rehabilitation unit 7=Acute hospital 8=Other 9=Died

30. Date of re-operation

31. Type of re-operation
   1=Removal implant 2=Hemiarthroplasty 3=Total hip arthroplasty
   4=Re-osteosynthesis (revision with internal fixation) 5=Grillestone/extension arthroplasty
   6=Drainage haematoma or infection 7=Reduction dislocation 8=Other (specify)

32. Reason for re-operation
   1=Fracture displacement 2=Loss of position of osteosynthesis material without fracture displacement
   3=Additional fracture around the implant 4=Non-union (pseudarthrosis). Non-union normally takes 3-6 months to occur so fracture displacement or loss of position of implant before this time should normally be coded as 1 or 2
   5=Femoral head necrosis (segmental collapse, avascular necrosis in a fracture that has healed)
   6=Local pain or tenderness at operation site or prominent implant causing discomfort with healed fracture
   7=Wound infection 8=Wound haematoma 9=Dislocation of arthroplasty
   10=Breakage of the implant 11=Disassembling of the implant
   12=‘Elective’ removal of implant. Fracture healed and no significant symptoms
   99=Other (specify)

33. Date of discharge or death in hospital

34. Discharged to (code as question 29)
Codes for "Admitted from"

1. Own home. Independent living accommodation although the person may receive assistance from relatives and outside agencies at home. Own, rented house, family member’s home.
2. Sheltered housing, warden controlled accommodation, special flat. Partly independent living accommodation where major assistance is given.
3. Institutional care. Long term/permanent placement in a full service residential home, home for the elderly or infirm where meals are provided but the patient is mobile and generally able to carry out basic activities of daily living (dressing, washing, feeding toileting). A social provision with minimum nursing input.
4. Nursing home. Long term/permanent placement in an institutional home which has provision of nursing facilities to provide assistance in the basic activities of daily living of dressing, washing and toileting.
5. Permanent hospital inpatient. Long term/permanent placement of a patient in hospital which has nursing and medical support and for which there are no plans for discharge.
6. Rehabilitation unit. Short term/temporary placement in either a community rehabilitation unit, temporary nursing care, geriatric assessment unit, respite care, convalescent home.
8. Other (specify)
9. Died (only applies when answering question 19, 34)
Appendix III

Following are the SAHFE extended data set hip fracture patient registration forms used in study IV and V (only form 4).
Standardised Audit of Hip Fractures in Europe

ABILITIES OF PATIENT IMMEDIATELY PRIOR TO THE FALL

FILLED IN

2. [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] Patient ID number

4. [ ] Side of fracture 1=left 2=right (If bi-lateral fracture, fill in two forms)

5. [ ] [ ] [ ] [ ] [ ] [ ] [ ] Date of fracture (If unknown, use date of admission)

7. [ ] Sex 1=male 2=female

41. [ ] Occurrence for registration 1=Prior 2=4 months follow-up 3=12 months follow-up

40. [ ] [ ] SPMSQ-test (score 0-10)
   1. State age (1 point for exact age only)
   2. Give current time (1 point only if correct to nearest hour)
   3. Address to remember then repeat at the end of the test (Use a three point address e.g. 42 Alexandria Road, Birmingham to recall. Score 1 if recalls correctly near beginning of test and at end of test)
   4. State present year. (1 point for current year only)
   5. Name of institution to which the patient has been admitted. (Score 1 only if exact hospital name is given, ‘in hospital’ is insufficient)
   6. Recognition of two people (score 1 if roles of two people are correctly recognised e.g. nurse, doctor).
   7. State date of birth (score 1 for correct date and month, year not required)
   8. Year of start of the first or Second World War. (Score 1 for correct year of start or finish of either war i.e. 1914, 1918, 1939, 1945. Only one year required)
   9. Name of present monarch or head of state. (Score 1 for current monarch/head of state only)
  10. Count backward 20-1. (Score 1 if no mistakes or subject corrects themselves spontaneously)

41. [ ] Dressing
   1=Able to dress completely without help from another person including shoes, stockings and to manage buttons/zippers. Excludes tying shoelaces.
   2=Needs a little help with buttons or zippers.
   3=Needs assistance with shoes and stockings (one or both legs).
   4=Needs assistance with up to 3 items.
   5=Needs to be dressed by others.

42. [ ] Bathing or taking a shower
   1=Able to bath or take a shower. May include use of accessories such as stool or handrail.
   2=Needs a little help in washing a single part of the body such as back or feet or need a bystander.
   3=Needs assistance getting in and out of the bathtub.
   4=Needs assistance in bathing one or more part of the body.
   5=Always needs to be bathed by others.

43. [ ] Feeding (not cooking or preparing meals)
   1=Can cut and eat without help from another person.
2=Needs help from others to cut hard food.
3=Needs assistance in handling food e.g. buttering of bread.
4=Needs a large amount of help to feed.
5=Cannot feed at all and has to be completely fed by others

44. Toileting
1=Can get to the toilet, get on and off, manage clothing etc. May include use of mechanical supports.
2=Needs assistance with getting to and from toilet.
3=Needs assistance getting on and off the toilet and adjusting clothing.
4=Needs assistance in cleaning organs of excretion.
5=Wears pad or used a catheter or bedpan at all times.

45. Shopping
1=Can do all shopping without assistance of another person but may use an aid such as a shopping trolley.
2=Needs assistance getting to or returning from the shops or can only shop independently for small purchases or
   patient is able to shop but gets somebody else to do it.
3=Needs assistance with selecting shopping, is unsure what he/she needs to buy or must always be accompanied
due to physical, psychological or visual impairment.
4=Needs help with two or more tasks associated with grocery shopping.
5=Completely unable to shop.

46. Housework
1=Able to manage the house alone or with only occasional assistance such as for heavy cleaning.
2=Able to perform all home maintenance tasks but needs some assistance e.g. lifting. Or patient is able to do it
   but somebody else does it anyway.
3=Able to perform only light daily tasks.
4=Needs assistance with light household duties.
5=Unable to do housework.

47. Laundry
1=Able to wash clothes by hand or with a machine.
2=Needs assistance going to laundry or hanging up laundry or patient is able to do but somebody else does it or
   would be able to do if had a machine at home.
3=Able to wash delicates and personal by hand or needs some assistance loading or unloading the machine.
4=Needs a large amount of help to do laundry.
5=Unable to do laundry.

48. Food preparation
1=Able to prepare food.
2=Patient is able to do but somebody else does it.
3=Able to prepare a small meal or sandwich if supplied with ingredients.
4=Able only to reheat foods.
5=Must have all meals prepared.

49. Banking and finances
1=Unable to manage all financial matters including going to bank, handling cash, performing transactions and managing income.
2=Needs assistance going to bank or does billing and banking by mail or cannot go to bank but able to perform all other financial tasks or is able to do it but somebody else does it anyway.
3=Able to manage day-to-day purchase but needs assistance with banking and major purchases.
4=Needs to be taken to the bank and requires other to handle the transactions and all other financial needs.
5=Unable to handle financial matters.

50. Use of transportation
1=Able to travel independently on public transportation, that is get on and off a bus or train, or drive a car.
2=Arranges own travel by taxi but does not use bus or train.
3=Must always be accompanied due to physical, psychological or visual impairment.
4=Travels in taxi or car only with assistance.
5=Unable to travel.

51. ADL-score (Calculate the sum of questions 41.-50. if all questions are answered.)

52. Social support and assistance
1=No assistance in normal activities of daily living (shopping, cooking, dressing, housework).
2=Needs some assistance in a few aspects of the more strenuous activities of daily living e.g. heavy shopping demanding housework.
3=Needs some assistance in a few aspects of the more strenuous activities of daily living e.g. heavy shopping demanding housework.
4=Needs assistance in washing and dressing, but can get to toilet independently.
5=Needs assistance in toileting and feeding.

53. Social support and assistance is provided by
1=No assistance necessary.
2=Spouse.
3=Other relatives.
4=Spouse and other relatives
5=Paid help either private provided or from the state.
6=Spouse and paid help.
7=Paid help and relatives.
8=Spouse, relatives and paid help.

54. Social support is economically provided by
1=Privately paid for (Informal care).
2=Provided by the state (Formal care).
3=None received.

55. Hours of social support received (Average hours per week of social services/home help received.)

56. Psychological state
Listed below are some statements about how people feel in their daily life. Please fill in the box under whichever answer (1=yes or 2=no) was most true for the patient before they broke their hip.

1. Do you enjoy the things you have used to? 1=yes 2=no
2. Do you feel yourself lonely? 1=yes  2=no
3. Do you find hard to make contact to people? 1=yes  2=no
4. Do you feel that there is nobody to be close to? 1=yes  2=no
5. Do you feel that you are burden to people? 1=yes  2=no
6. Do you enjoy a good book, radio or TV program? 1=yes  2=no

<table>
<thead>
<tr>
<th>Blood haemoglobin (Hb) (g/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum creatinine (µmol/l)</td>
</tr>
<tr>
<td>Serum albumen (g/l)</td>
</tr>
<tr>
<td>Height (m)</td>
</tr>
<tr>
<td>Weight (kg)</td>
</tr>
<tr>
<td>Body mass index, BMI</td>
</tr>
<tr>
<td>Age of menarche</td>
</tr>
<tr>
<td>Age of menopause</td>
</tr>
</tbody>
</table>

Concomitant diseases (In following questions fill in 1=yes, 2=no)

<table>
<thead>
<tr>
<th>Cardiovascular disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous stroke</td>
</tr>
<tr>
<td>Respiratory disease</td>
</tr>
<tr>
<td>Renal disease</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>Rheumatoid disease</td>
</tr>
<tr>
<td>Parkinson’s disease</td>
</tr>
<tr>
<td>Malignant disease</td>
</tr>
<tr>
<td>Paget’s disease</td>
</tr>
<tr>
<td>Smoking</td>
</tr>
<tr>
<td>On oral steroids</td>
</tr>
</tbody>
</table>

Falls during last year before hip fracture / during 4 months / one year follow-up

1=No.
2=Up to three falls.
3=More than three falls.

<table>
<thead>
<tr>
<th>Fear of fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=No.</td>
</tr>
<tr>
<td>2=Yes.</td>
</tr>
</tbody>
</table>
ADDITIONAL DETAILS OF THE INJURY AND TREATMENT

FILLED IN  /

2.  |    |    |    |    |    |    |  Patient ID number

4.  |_| Side of fracture  1=left  2=right (If bi-lateral fracture, fill in two forms)

5.  |    |    |    |    |    |    | Date of fracture  (If unknown, use date of admission)

7.  |_| Sex  1=male  2=female

80.  |_| Place of fall
       1=At own home.
       2=Indoors but not at own home or hospital.
       3=Outdoors.
       4=Hospital, institution, sheltered housing.
       5=No fall (a spontaneous fracture, which occurred without injury).

81.  |_| Other coexistent fracture(s)
       1=Upper limb fracture.
       2=Additional lower limb fracture.
       3=Other upper and lower limb fractures.
       4=Other fracture not of limbs.
       5=Fracture of limb(s) and other areas of body.

82.  |_| Time of admission  (To the nearest hour, 24-hour clock)

84.  |_| Time of occurrence of hip fracture  (To the nearest hour, 24-hour clock)

85.  |_| Time of start of operation  (To the nearest hour, 24-hour clock)

86.  |_| Delay to operation  (If the patient waited more than 24 hours from the time the fracture was diagnosed to having their operation, indicate the cause of the delay. If more than 1 reason for the delay, you can fill in up to 3 reasons.)
       1.0=No delay (i.e. operation within 24 hours after fracture).
       2.0=Prior to admission to orthopaedic ward.
       3.0=To establish/confirm the diagnosis (specify or classify as below 3.1-3.4).
       3.1=Diagnosis confirmed by later review.
       3.2=Diagnosis confirmed by repeat x-rays.
       3.3=Diagnosis confirmed by bone scan.
       3.4=Diagnosis confirmed by CT scan.
       3.9=Other method of confirming diagnosis, specify: _____________________________________
       4.0=Administrative delay, specify: ___________________________________________________
       4.1=Lack of hospital bed on orthopaedic ward.
       4.2=Lack of available theatre space.
4.3=No surgeon available.
4.4=No anaesthetist available.
4.9=Other cause delay, specify: ______________________________________________________
5.0=The fracture was initially treated conservatively.
6.0=Operation delayed as patient was medically unfit.
6.1=Electrolyte imbalance.
6.2=Diabetes mellitus to stabilise.
6.3=Chest condition (treatment of).
6.4=Rehydration.
6.5=Transfusion for anaemia.
6.6=Congestive cardiac failure (treatment of).
6.7=Cardiac arrhythmia (treatment of).
6.8=Gastrointestinal bleed.
6.9=Other, specify: _______________________________________________________________
7.0=To assess medical state (get results of investigations etc.).
8.0=No reason apparent.

87. ___ Grade of surgeon (Indicate the grade of surgeon who performed the operation. A ‘fully qualified’ surgeon refers to one who has completed their orthopaedic training. If a trainee surgeon was assisting a fully qualified surgeon then it is classified as 1.)
   1=Qualified/specialist.
   2=Staff grade surgeon/associate specialist (permanent member of the hospital staff but below level of category 1).
   3=A trainee surgeon on a training scheme.
   4=Other trainee surgeon but not on a trainee scheme.
   5=Locum or temporary surgeon.
   6=Other, specify: _______________________________________________________________

88. ___ Type of surgeon (Speciality of operating surgeon. Choose the most appropriate category for the surgeon mentioned in question 87. An orthopaedic surgeon refers to one who does elective orthopaedic and emergency orthopaedic surgery, whilst a general surgeon is one who specialises in another branch apart from orthopaedics. A traumatologist only does emergency accident/trauma surgery.)
   1=Orthopaedist/orthopaedic.
   2=Traumatologist.
   3=General surgeon.
   4=Other, specify: _______________________________________________________________

89. ___ Grade of anaesthetist (Indicate the grade of anaesthetist who performed or who directly supervised the anaesthetic.)
   1=Qualified/specialist.
   2=Staff grade anaesthetist/associate specialist (permanent member of the hospital staff but below level of category 1).
   3=A trainee anaesthetist.
   4=An anaesthetic technician.
   5=Locum or temporary anaesthetist.
   6=Other, specify: _______________________________________________________________
90. **Length of surgery** (From start to finish of the operative procedure (knife to skin time to closure of the wound) in minutes.)

91. **Length of surgery and anaesthetic time** (This should include the time from the start to finish of the anaesthetic. It can be estimate from the anaesthetic record or theatre records. Record in minutes.)

92. **Type of anaesthetic**
1=General.
2=Spinal or epidural.
3=Local blocks and infiltration.
4=Other, specify: _______________________________________________________

93. **Operative blood loss** (ml)

94. **Volume of packed blood transfused prior to surgery** (ml)

95. **Volume of packed blood transfused in the 5 days from surgery** (ml)

96. **Haemoglobin, Hb, immediately after surgery** (g/l)

97. **Haemoglobin, Hb, day one after surgery** (g/l)

98. **Cement used to fix fracture of prosthesis** 1=yes 2=no

99. **Surgical approach for arthroplasty**
1=Anterior
2=Anterolateral
3=Lateral with osteotomy
4=Posterior

100. **Use of growth factor** 1=yes 2=no

101. **Thromboembolic prophylaxis used** (Detail which if any forms of thromboembolic prophylaxis were used.)
1.0=Mechanical, specify if not 1.1-1.3: ____________________________________________
1.1=Graduated stockings below knee.
1.2=Graduated stockings above knee.
1.3=Foot pump.
1.4=Pneumatic calf compression.
2.0=Heparin (other or unknown type).
2.1=Conventional heparin.
2.2=Low molecular weight heparin.
3.0=Warfarin.
4.0=Dextran
5.0=Aspirin.
6.0=No prophylaxis used.
7.0=Other, specify: ___________________________________________________________
102. Commencement of thromboembolic prophylaxis.
   1.0=Before surgery.
   1.1=Within 6 hours of admission but before surgery.
   1.2=Within 12 hours of admission but before surgery.
   1.3=Within 24 hours of admission but before surgery.
   1.4=More than 24 hours after admission but before surgery.
   2.0=After surgery.
   2.1=Within 6 hours of after surgery.
   2.2=Within 12 hours after surgery.
   2.3=Within 24 hours after surgery.
   2.4=More than 24 hours after surgery.

103. Duration of thromboembolic prophylaxis in days

104. Antibiotic prophylaxis  1=yes  2=no

105. Time in days from surgery to mobilisation

106. Time in days to be allowed to fully weight bear
### ADDITIONAL DETAILS OF THE TYPE OF FRACTURE AND REDUCTION

<table>
<thead>
<tr>
<th>No.</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Patient ID number</td>
</tr>
<tr>
<td>4.</td>
<td>Side of fracture 1=left 2=right (If bi-lateral fracture, fill in two forms)</td>
</tr>
<tr>
<td>5.</td>
<td>Date of fracture (If unknown, use date of admission)</td>
</tr>
<tr>
<td>7.</td>
<td>Sex 1=male 2=female</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>107.</td>
<td>AO classification of all fractures</td>
</tr>
<tr>
<td>108.</td>
<td>Garden grade of intracapsular fracture</td>
</tr>
<tr>
<td>109.</td>
<td>Pauwels grade of intracapsular fracture</td>
</tr>
<tr>
<td>110.</td>
<td>Jensen &amp; Michaelsen classification of trochanteric fracture</td>
</tr>
<tr>
<td>111.</td>
<td>Preoperative Garden alignment index on antero-posterior radiograph (degrees)</td>
</tr>
<tr>
<td>112.</td>
<td>Preoperative Garden alignment index on lateral radiograph (degrees)</td>
</tr>
<tr>
<td>113.</td>
<td>Additional classification of intracapsular fractures</td>
</tr>
<tr>
<td>114.</td>
<td>Singh grade of osteoporosis</td>
</tr>
<tr>
<td>115.</td>
<td>Osteoporosis as measured by DEXA</td>
</tr>
<tr>
<td>116.</td>
<td>Postoperative Garden alignment index on antero-posterior radiograph (degrees)</td>
</tr>
<tr>
<td>117.</td>
<td>Postoperative Garden alignment index on lateral radiograph (degrees)</td>
</tr>
</tbody>
</table>
ADDITIONAL DETAILS OF COMPLICATIONS

2. [ ] [ ] [ ] [ ] [ ] [ ] - [ ] [ ] [ ] Patient ID number

4. [ ] Side of fracture 1=left 2=right (If bi-lateral fracture, fill in two forms)

5. [ ] [ ] / [ ] [ ] [ ] Date of fracture (If unknown, use date of admission)

7. [ ] [ ] Sex 1=male 2=female

119. [ ] Occurrence for registration
   1=At discharge.
   2=At 4 months follow-up.
   3=At 12 months follow-up.

120. [ ] Occurrence of pressure sores on buttock or sacrum
   1=None.
   2=Non blanching erythema of intact skin. That is a red, violet area of skin that does not blanch when pressed, indicating that blood had escaped from capillaries into the interstitial tissues.
   3=Partial thickness skin loss. The skin surface is broken resulting in an abrasion or crater.
   4=Full thickness skin loss and extension into subcutaneous fat but not through underlying facia.
   5=Extensive destruction involving damage to muscle, bone or tendon.

121. [ ] Occurrence of pressure sores on heel
   1=None.
   2=Non blanching erythema of intact skin. That is a red, violet area of skin that does not blanch when pressed, indicating that blood had escaped from capillaries into the interstitial tissues.
   3=Partial thickness skin loss. The skin surface is broken resulting in an abrasion or crater.
   4=Full thickness skin loss and extension into subcutaneous fat but not through underlying facia.
   5=Extensive destruction involving damage to muscle, bone or tendon.

122. [ ] Occurrence of pressure sores on any other area
   1=None.
   2=Non blanching erythema of intact skin. That is a red, violet area of skin that does not blanch when pressed, indicating that blood had escaped from capillaries into the interstitial tissues.
   3=Partial thickness skin loss. The skin surface is broken resulting in an abrasion or crater.
   4=Full thickness skin loss and extension into subcutaneous fat but not through underlying facia.
   5=Extensive destruction involving damage to muscle, bone or tendon.
Occurrence of complications  (In following questions use 1=yes, 2=no)

123. ___ Chest infection  (Signs in chest and antibiotic treatment)
124. ___ Cardiac failure  (Necessitating treatment)
125. ___ Deep vein thrombosis  (Confirmed by ultrasound of venography)
126. ___ Pulmonary embolism  (Confirmed by lung scan or angiography)
127. ___ Superficial wound infection  (Redness of the wound requiring antibiotics)
128. ___ Deep wound infection  (Infection around the implant)
129. ___ Wound haematoma  (Necessitating drainage)
130. ___ Urine retention  (Necessitating catheterisation)
131. ___ Urine infection  (Confirmed by culture)
132. ___ Acute renal failure  (Doubling of serum urea or creatinine)
133. ___ Gastrointestinal haemorrhage  (Haematemesis tai maelena)
134. ___ Myocardial infarctation  (Changes in ECG and clinical features)
135. ___ Cerebrovascular accident
136. ___ Other, specify: ____________________________________________________