TÍTULO EN INGLÉS

Hip fracture in the elderly: outcomes and associated factors

TÍTULO EN ESPAÑOL

Dependencia funcional a corto, medio y largo plazo tras una fractura de cadera: Factores asociados

Memoria presentada por María Patrocinio Ariza Vega
para aspirar al grado de Doctor

DIRECTORES DE LA TESIS

José Juan Jiménez Moleón Morten Tange Kristensen

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D. JOSÉ JUAN JIMÉNEZ MOLEÓN, Doctor en Medicina y Profesor Titular del Departamento de Medicina Preventiva y Salud Pública de la Universidad de Granada

CERTIFICA que:

la Tesis Doctoral titulada "**DEPENDENCIA FUNCIONAL A CORTO, MEDIO Y LARGO PLAZO TRAS UNA FRACTURA DE CADERA: FACTORES ASOCIADOS**" ha sido realizada por **Doña María Patrocinio Ariza Vega**. El trabajo presentado ha sido realizado bajo mi dirección y demuestra la capacidad técnica e interpretativa de su autora en condiciones tan aventajadas que le hacen acreedora del título de Doctora, siempre que así lo considere el Tribunal designado para su juicio por el Comité de Dirección de la Escuela de Doctorado de Ciencias de la Salud de la Universidad de Granada.

Granada, noviembre de 2013

Fdo. José J. Jiménez Moleón

D. MORTEN TANGE KRISTENSEN, Doctor en Fisioterapia e Investigador Senior del Centro de Investigación de Medicina Física y Rehabilitación en Copenhague - (PMR-C) y de los Departamentos de Fisioterapia y Cirugía Ortopédica del Hospital Universitario Hvidovre de Copenhague, Dinamarca.

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Fdo. Morten Tange Kristensen

A mis padres

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ABBREVIATIONS

ADL: Activities of Daily Living

ASA: American Society of Anesthesiologists range

CI: Confidence Interval

FIM: Functional Independence Measure

HZ: Hazard Ratio

ICF: International Classification of Functioning

NWB: Non weight-bearing

SD: Standard Deviation

WB: Weight-bearing

WBAT: Weight-bearing as tolerated

Contents

1.

Abstract

Hip fracture is a major public health problem in the elderly due to the high incidence, the outcomes and the cost of this pathology. The loss of function and the high likelihood of mortality even one year after the fracture show the need for new strategies of treatment for these patients.

The overall aims of this thesis, which comprises three studies (one published and two in review), including a total of 275 patients, were to determine the functional outcomes, the mortality, and the factors influencing these outcomes, within one year after hip fracture surgery.

We carried out a prospective observational cohort study between February 2009 and January 2010, at the Traumatology Service Hospital of Jaen. The 275 consecutive patients followed met the following inclusion criteria: 1) Age 65 and older; 2) Having surgery after the hip fracture; 3) Surviving the first 24 hours after surgery; 4) Absence of terminal disease; 5) Six months or more living in Jaen; 6) Accept to participate and sign the informed consent. Patients and/or their relatives were interviewed by one experienced therapist-interviewer during the hospital stay after surgery (first interview), at one month (second interview) and three months (third interview) coinciding with Traumatology revisits and at one year after surgery (the last interview was done by phone). The outcome measures were the functional level (measured by the Functional Independence Measure) and the Mortality. Sociodemographic, clinical and treatment variables were attained from the medical records and the interviews. For patients with cognitive impairment, the closest relative or caregiver signed the informed consent. The ethics committee of the Hospital of Jaen approved this study.

We found that only 25 patients (11.5%) fully regained the same FIM score that they had before hip fracture. The functional recovery was not achieved in all the Activities of Daily Living (ADL) items within one year of fracture for most of the patients, and there

were differences in the time required to regain functionality in the activities analysed. The main recovery predominantly took place during the first three months for patients allowed weight bearing (WB) after surgery, while patients not allowed WB in the first two to four weeks after surgery had a higher rate of recovery in the following months. The activities most affected one year after surgery were dressing lower body, bathing/showering, transfer bathtub/shower and walking up/down stairs.

A significant number of patients had to change their residential status within one year following the hip fracture, and typically these patients were those who lived alone prior to the fracture.

Patients who had two to four weeks of non-WB (NWB) status following surgery had a significant and clinically important decrease in their functional level at one year after surgery when we compare with the patients allowed WB. The other significant variables associated with the loss of the function were low prefracture functional level, cognitive impairment, age and having an intracapsular fracture.

Mortality one year after surgery occurred in 21% of cases and the main associated factors were men sex, cognitive impairment, high Charlson index score, NWB status and change of residence.

These results suggest that the treatment of these patients was not the best and some proposals to improve the care could be: 1) The practice of early WB should be fostered at the hospital by the surgeons and all the team that work with these patients at the hospital; 2) The rehabilitation programs should include all patients, and not be based only on mobility activities, the recovery of other ADL should also be included. Further studies should evaluate if extended rehabilitation could improve the long-term outcome because the rehabilitation provided was insufficient to return patients to their previous

functional level; 3) It is necessary to have better coordination with the social services, and the patients should have the opportunity to have the main portion of care and rehabilitation at their home; 4) Patients that display the predisposing risk factors for mortality could be monitored more closely after surgery.

2.

Introduction

2.1. Definition and classification of hip fracture.

A hip fracture or femoral fracture refers to “a fracture of the proximal femur down to about 5 cm below the lower border of the lesser trochanter” (Parker et al. 1992)

Hip fractures may be classified according to their anatomical location as intracapsular or extracapsular, depending whether the fracture is inside or outside of the capsule of the hip joint. Intracapsular fractures include subcapital and cervical fractures (Parker et al. 2005), while extracapsular fractures consist of basicervical, trochanteric and subtrochanteric fractures. Basicervical fractures are considered by various authors as either extracapsular or intracapsular (Parker et al. 2005). Basicervical fractures may cross the capsular attachments but their treatment and prognosis are similar to a trochanteric fracture (Parker et al. 2005)

Intracapsular fractures

Intracapsular fractures are classified by the Gardens classification (Garden et al. 1961) which consists of four subtypes: Grade I: incomplete fracture of the neck (so-called abducted or impacted); Grade II: complete without displacement; Grade III: the fracture is a complete and partially displaced fracture with alignment of the femoral neck relative to the neck in varus deformity; Grade IV: is a complete fracture with complete displacement (Figure 1)

The intracapsular fractures are classified too as displaced or undisplaced (Frandsen et al. 1988) and the treatment will be different if the fracture is displaced or undisplaced.

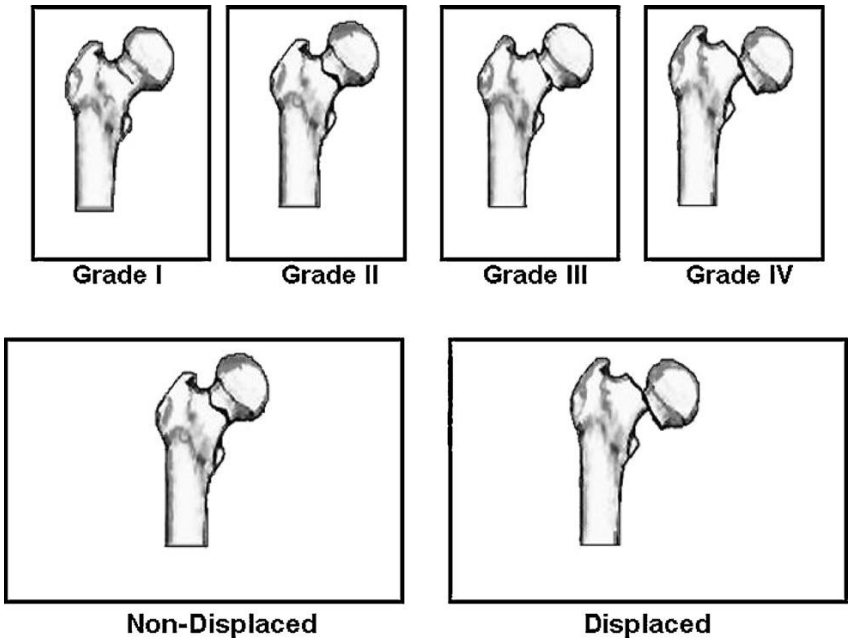

Figure 1. Gardens classification (Van Embden et al. 2010)

The appropriate treatment for undisplaced intracapsular fractures is the fixation with multiple compression screws (Parker et al. 2005) (Figure 2a). A total hip arthroplasty is recommended only if there are signals of avascular necrosis of the femoral head (happens in 5-15% cases) (Parker et al. 2005). Undisplaced subcapital fractures are the only type of fracture that could be treated with conservative treatment but with a short period of bed rest and subsequent mobilization. (Parker et al.1992).

The displaced intracapsular fractures should be treated with hemiarthroplasty or total arthroplasty (Figure 2b). Another option would be with internal fixation, but with this technique there is a non-union in 30% of cases and avascular necrosis in 15% of cases. The conservative treatment is not indicated in displaced intracapsular fractures due to the non-union (Parker et al. 1992).

2a 2b

Figure 2. Fixation with parallel pins (figure 2a) and Hemiarthroplasty (figure 2b). *(Reprinted from, Hip fractures: functional assessments and factors influencing in-hospital outcome, a physiotherapeutic perspective. Morten Tange Kristensen. Thesis, Lund University. Sweden. 2010).*

Extracapsular Fractures

Various classification systems have been used to classify extra-capsular hip fractures. The ideal classification system should be useful in planning treatment and predicting outcomes. The most frequently used system is the Jensen (Jensen et al. 1980) and Michaelsen's (Jensen et al. 1975) modification of Evans classification (Van Embden et al. 2010) (Figure 3). More recently, the AO/ASIF classification system (the fracture classification proposed by Muller et al. and adopted by the Orthopaedic Trauma Association) has been advocated (Figure 4). However a report carried out by Pervez et al. showed that the usage of the AO classification was most reliable when the subgroups were not included (Pervez et al. 2002, Van Embden et al. 2010).

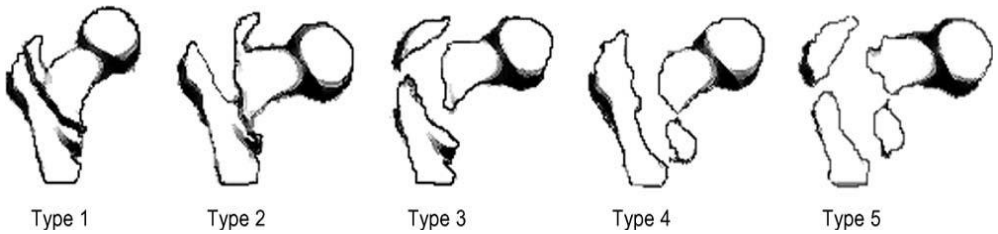

Figure 3. Jensen's modification of the Evans classification (Van Embden et al. 2010)

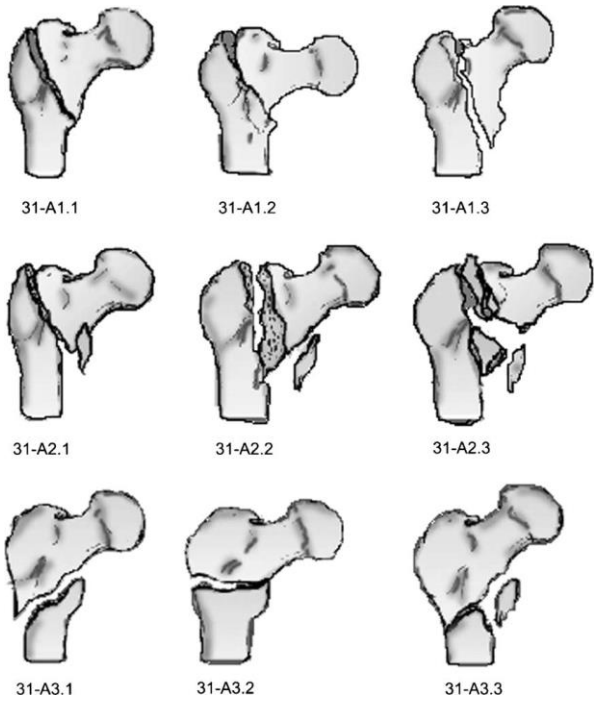

Figure 4. The AO/ASIF classification for trochanteric femur fractures, proposed by Mu¨ ller et al. (Van Embden et al. 2010).

AO group A1 fractures are two part trochanteric fractures, which may be displaced or undisplaced and are equivalent to Jensen classification types 1 and 2. AO group A2 fractures are comminuted and unstable, and equivalent to Jensen types 3, 4 and 5. AO group A3 fractures are at the level of the lesser trochanter and may be transverse, oblique or reversed (Pervez et al. 2002).

Extracapsular fractures should be treated using a sliding hip screw or an intramedullary nail (Stern et al. 2007, Kumar et al. 2012) (figure 5). When the fracture happens in the

subtrochanteric area the most frequent technique used is an intramedullary nail. They can use a sliding hip screw but with a longer side plate (Parker et al. 2005).

5a 5b

Figure 5. Sliding hip screw (figure 5a) and short intramedullary nail (figure 5b). (Reprinted from, *Hip fractures: functional assessments and factors influencing in-hospital outcome, a physiotherapeutic perspective. Morten Tange Kristensen.Thesis, Lund University. Sweden. 2010).*

2.2. Epidemiology

2.2.1. Magnitude of the problem

Hip fracture is a global public health concern due to the high incidence, the poor outcomes and the cost of this pathology (Abrahamsen et al. 2009, Brauer et al. 2009, Leslie et al. 2009, Alarcon et al. 2010, Curran et al. 2010, Dhanwal et al. 2011, Sterling et al 2011, Librero et al. 2012, Tarazona-Santabalbina et al. 2012). As a result of an increase in the elderly population, the number of hip fractures is expected to rise and put significant strain on the provision of medical care. It is estimated that the number of hip fractures worldwide will increase from 1.66 million in 1990 to 2.6 million in 2025,

and between 4.5 million and 6.3 million in 2050 (Dhanwal et al. 2011, Sterling et al. 2011).

However, this rapid rise in fracture rate has not been universally observed (Green et al. 2010). Since 1995 hip fractures rates have decreased for both men and women in the US (Brauer et al. 2009, Melton et al. 2009), Canada (Leslie et al. 2009) and north Europe (Lofman et al. 2002, Abrahamsen et al. 2010), but not in other countries like Germany (Icks et al. 2008) or Austria (Mann et al. 2010a, Mann et al. 2010b). In the north of Europe the incidence increased in women aged 90 or older (Bergstrom et al. 2009) and nowadays, most of the fractures occur among 75 years and older (Brauer et al. 2009).

Even though the rates appear to be decreasing in some countries, the incidence of hip fracture continues to be high with geographical variations. The lowest rates are in Asia (Dhanwal et al. 2011) and Latin america (Riera-Espinoza et al. 2009), followed by Southern European countries (De Pina et al. 2008, Alarcon et al. 2010) but are highest in North Europe (Jaatinen et al. 2007, Omsland et al. 2012) and North America (Brauer et al. 2009). These variations could be explained by demographic differences in the population (more elderly living in countries with higher incidence rates), ethnicity, latitude and environmental factors (Dhanwal et al. 2011, Sterling et al. 2011). Changes in those factors will affect the future incidence of hip fractures, so it is expected that in 2050 half of hip fractures worldwide will happen in Asia due to the increase of elderly people (Dhanwal et al. 2011).

Gender differences have been reported with a higher incidence in women than in men 3:1 (Brauer et al. 2009). Men are an average of 3-6 years younger than women and they have more comorbidities at the time of the fracture (Sterling et al. 2011). Race

differences have shown a lower incidence in African American and Hispanic people than in white people, but they also tend to be younger and there is a higher incidence in men than for Caucasian people at the moment of the hip fracture (Sterling et al. 2011).

In Spain, the incidence of hip fracture is higher than 100 per 100.000 inhabitants per year, and more than 500 per 100.000 in elderly people, being 75% more frequent in women (Alvarez-Nebreda et al. 2008, Librero et al. 2012). In the Andalusia region the incidence is 99 per 100.000 inhabitants (httsps.es/estadEstudios/estadisticas/ cmbdhome.htm.). The Spanish population older than 65 years has been projected to increase from 15.5% in the year 1980 to 28.6% in the year 2025 (Tarazona-Santabalbina et al. 2012). Accordingly, the incidence of hip fractures will likely be higher in the coming years without changes to the prevention and treatment of this pathology.

2.2.2. Outcomes of hip fracture

Literature has shown that the main outcomes of a hip fracture are the high related mortality and morbidity, the loss of functional independence, the subsequent diminished quality of life and the burden of care involved (Rosell et al. 2003, Kristensen et al. 2010, Ziden et al. 2010, Dhanwal et al. 2011, Kristensen et al. 2011)

Outcomes of a hip fracture affect different areas of the person and their environment. The outcomes after a hip fracture and the factors related with those outcomes can be classified using the International Classification of Functioning (ICF). The ICF is a classification of "Components of health" that identifies the constituents of health as a result (WHO 2002). ICF provides a description of situations with regard to human

functioning, understanding functioning as “all body functions, activities and participation” (WHO 2002). This classification includes environmental factors that interact with all these components.

ICF classifies this information in two sections: 1) Functioning and Disability, and 2) Contextual Factors. At the same time, each section is divided in two other sections: 1.1) Body function and structures, and 1.2) Activities and participation for Functioning and Disability; 2.1) Environmental Factors, and 2.2) Personal Factors for Contextual Factors. Table 1 shows all the components, some definitions included in the ICF, and the factors affecting outcomes of hip fracture shown in the literature.

Table 1. An overview of ICF (WHO 2002) and related factors with hip fracture

	Definitions of Component	Factors
1. Functioning and Disability		
1.1 Body Functions and Structures	They can be interpreted by means of changes in physiological systems or in anatomical structures. Body functions are the physiological functions of body systems (including psychological functions. Body structures are anatomical parts of the body such as organs, limbs and their components.	Comorbidity Health status Cognitive impairment Type of fracture Anaemic Body mass index Nutrition Post-surgery complications

This table continue in the following page

1.2. Activities and Participation	They cover the complete range of domains denoting aspects of functioning from both an individual and a societal perspective. Activity is the execution of a task or action by an individual. Participation is involvement in a life situation. Activity limitations are difficulties an individual may have in executing activities. Participation restrictions are problems an individual may experience in involvement in life situations.	Functional level.
2. Contextual Factors		
2.1 Environmental Factors	They make up the physical, social and attitudinal environment in which people live and conduct their lives. They have an impact on all components of functioning and disability and are organized in sequence from the individual's most immediate environment to the general environment.	Economic Time to surgery Type of surgery Prefracture residence status Discharge residence Rehabilitation Weight- bearing status Place of the fall Type of unit hospital (orthopaedic, orthogeriatric)
2.2 Personal Factors	They are not classified in the ICF because of the large social and cultural variance associated with them.	Age Gender

The individual's functioning is defined as “an interaction or complex relationship between the health condition and contextual factors” (WHO 2002). The following diagram shows the interactions between the components of ICF

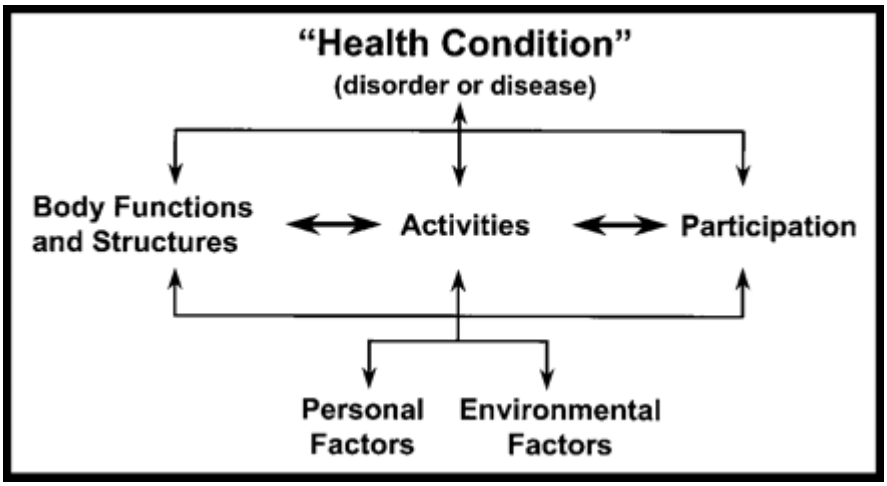

Figure 6. Model of the International Classification of Function (WHO 2002).

2.2.3. Functional Outcomes

Only a third of patients recover their previous level of ADL at one year following a hip fracture (Candel-Parra et al. 2008, Penrod et al. 2008, Bentler et al. 2009).

Factors that influence the functional outcome after a hip fracture in the elderly have been identified by several studies (Rosell et al. 2003, Haentjens et al. 2005, Di Monaco et al. 2007, Adunsky et al. 2008, Deakin et al. 2008, Hommel et al. 2008, Browne et al. 2009, Semel et al. 2010, Kristensen et al. 2011) including post injury mobilisation status and the need for help with activities of daily living (ADL) (Heikkinen et al. 2005, Foss et al. 2006, Hakkinen et al. 2007). The importance of both early weight bearing (WB) and mobilization have been evaluated in a number of studies (Adunsky et al. 2001, Barone et al. 2009, Wu et al. 2009, Siebens et al. 2012) and

there is an awareness that immediate, optimised treatment of patients with hip fracture can positively influence the outcomes after operation. However the decision to allow early and full WB (practiced as weight bearing as tolerated (WBAT)) after hip fracture (recommended by the clinical guidelines) continues to differ from one country to another (even from one service to another in the same country), showing great variability in clinical practices.

Furthermore, knowledge of the main factors that influence the outcomes is important to establish the optimal time for the rehabilitation and follow-up of these patients, as some specific functional activities take longer times to return to prior levels (Munin et al. 2010, Ziden et al. 2010, Bertram et al. 2011). In northern Europe, recovery times may take from four months to over 12 months (Heikkinen et al. 2005). In southern Europe, meanwhile, there is a lack of knowledge about the recovery of the functional level after a hip fracture, and the potential changes to residential status due to the loss of functionality.

The risk of losing their previous social setting due to a change in their place of residence is an important issue for hip fracture patients, (Harris et al. 2010, Johansen et al. 2010), due to the loss of social relationships (Chiu et al. 2012). Declines in social relationships appear larger after a hip fracture as compared to other fracture types in elderly women (Chiu et al. 2012), and lower amounts of social contact are associated with mortality in elderly people with hip fractures (Mortimore et al. 2008).

Accordingly, preventative strategies should have a high priority in addition to eliminating all possible factors influencing the post-surgery outcome, in order to return patients to their pre-fracture functional level as quickly as possible, and to enable them to maintain or return to their previous social setting (Alarcon et al. 2011).

2.2.4. Mortality

The increased risk of death after hip fracture is well documented (Bass et al. 2007, Vestergaard et al. 2007, Abrahamsen et al. 2009, Vestergaard et al. 2009, Haentjens et al. 2010, Juliebo et al. 2010), with one year mortality ranging from 8.4% (in a Swedish study) to 36% (in a US study) with geographical variations (Hu et al. 2012, Abrahamsen et al. 2009). Currently it is not known if the different rates of mortality between countries are due to the variations in the demographics of patients, or due to the diversities in treatment methods (Haleem et al. 2008).

The factors associated with increased mortality at one year are not well established (Castronuovo et al. 2011, Johansen et al. 2010, Hu et al. 2012, Alegre-Lopez et al. 2005, Browne et al. 2009, Holvik et al. 2010). Still, the main factors associated with excess mortality after hip fracture as shown in the literature are:

- The advanced age (Castronuovo et al. 2011, Johansen et al. 2010, Librero et al. 2012, Gonzalez-Rozas et al. 2012, Lefaivre et al. 2009, Frost et al. 2011, Vochteloo et al. 2011).
- Male gender (Bass et al. 2007, Haentjens et al. 2007, Haleem et al. 2008, Penrod et al. 2008, Lefaivre et al. 2009, Kannegaard et al. 2010, Haentjens et al. 2010, Frost et al. 2011, Sterling et al. 2011, Vochteloo et al. 2011).
- Multiple comorbidities (Bergeron et al. 2009, Lefaivre et al. 2009, Castronuovo et al. 2011, Pioli et al. 2011, Librero et al. 2012, Norring-Agerskov et al. 2013).
- Higher ASA grading (Soderqvist et al. 2009, Johansen et al. 2010, Norring-Agerskov et al. 2013).
- Poor prefracture functional status (Dubljanin-Raspopovic et al. 2012, Gonzalez-Rozas et al. 2012, Hu et al. 2012).
- Dementia or cognitive impairment (Hershkovitz et al. 2010, Castronuovo et al. 2011, Hu et al. 2012) have been reported by several studies.

- Nursing home or facility living residence (Hu et al. 2012).

However there are other factors that need to be studied more in depth because there are both conflicting results in the literature, and a small number of reports that include these factors:

- Type of fracture (Haentjens et al. 2007, Sund et al. 2009, Kos et al. 2011).
- Residence status: including prefracture living residence (Johansen et al. 2010). and residence at discharge (Harris et al. 2010).
- Time to surgery (Zuckerman et al. 1995, Novack et al. 2007, Bryson et al. 2008, Smektala et al. 2008, Verbeek et al. 2008, Khan et al. 2009, Leung et al. 2010, Carretta et al. 2011, Pioli et al. 2012, Librero, et al. 2012).
- Anaemic status (Vochteloo et al. 2011)
- Weightbearing status

There are some controversies around the preoperative risk factors for the high mortality, and accordingly the mortality rate of hip fracture patients continues to be very high. Therefore more studies are needed to identify the predisposing factors, and to clarify the most predominant of these factors. Knowledge of the risk factors for mortality in hip fracture patients is important because we can then identify patients who have a higher risk of mortality, and use the knowledge to design new care models and treatment methods that demonstrably reduce the high mortality rates.

2.2.5. Economic costs

Hip fracture in elderly patients is the most frequent cause of hospital admission in the Orthopaedics services in Spain (httsps.es/estadEstudios/estadisticas/cmbdhome.htm.).

In the US, a patient with a hip fracture spends 40.000$ (30.128 euros) for medical cost during the first year after the hip fracture and 5000$ (3.766 euros) in subsequent years (Brauer et al. 2009). In the EU the cost of the treatment is 25.000 million euros in addition to 15.000 million euros for the care of patients during the first year after hip fracture. These costs do not include the care of the following years (Manzarbeitia 2005), and so underestimate the full cost.

In Spain, in 2008, the cost of the hospitalizations in the National Health System due to hip fractures was 395.7 million euros. The spending per case was between 8.000 (httsps.es/estadEstudios/estadisticas/cmbdhome.htm.) and 10.000 euros (Manzarbeitia 2005). The exact amount provided by the Ministry of Health and Social Policy of Spain was 8.365,25 euros per case in 2008, and the amount showed by a study presented in the 5th European Congress on clinical and economic aspects of the osteoporosis and osteoarthritis was 9.936 euros per case per year (Manzarbeitia 2005).

Indirect costs have a very significant importance, but they are rarely taken into account when assessing the impact of pathologies (Manzarbeitia 2005). After a hip fracture, many patients will severely lose their previous level of autonomy, and will require the presence of a caregiver to help them with everyday tasks. Productivity losses of family members of hip fracture patients are frequently not accounted for, but certainly there can be significant impacts on the economies of the relatives of a patient with hip fracture (Manzarbeitia 2005). This issue is even more important in countries such as Spain where the caregivers of elderly patients are usually their relatives.

2.3.Treatment

Clinical guidelines are a tool designed to achieve the best results from the treatment of patients, to increase hospital efficiency, and to reduce the variability in clinical practice (Bardales-Mas et al. 2012). The clinical guidelines considered in this document are:

1) Best practice evidence-based guideline. Acute management and immediate rehabilitation after hip fracture amongst people aged 65 years and over. New Zealand Guidelines Group. Wellington, 2003 (NZCG).
2) The care of patients with fragility fracture. The Blue Book. Published by the British Orthopaedic Association. London, 2007 (BOABGS).
3) Guía de buena práctica clínica en Geriatría. Anciano afecto de fractura de cadera, Sociedad Española de Geriatría y Gerontología -Sociedad Española de Cirugía Ortopédica y Traumatológica. 2007 (SEGG-SECOT).
4) Prevention and management of hip fracture in older people. A National Clinical Guideline. Scottish Intercollegiate Guidelines Network. Edinburgh, 2009. (SIGN).

Some of the main recommendations of the clinical guidelines (NZGC 2003, BOA-BGS 2007, SEGG-SECOT 2007, SIGN 2009) for hip fractures patients include:

1. Assessment protocol in the emergency department and fast transfer to the orthopedic service within the first four hours after the fracture.
2. Comprehensive patient assessment; including comorbidity, medication, functional status, cognitive status and social status.
3. Intravenous fluid therapy if risk of dehydration and hypovolemia
4. Preventive strategies:

a. Prophylaxis of venous thromboembolism: the SIGN recommends the mechanical prophylaxis and the use of acetylsalicylic acid while the SEGC-SECOT recommends the use of low molecular weight heparins.
b. Prevention of pressure ulcers: using special foam or air mattresses, frequent assessment of skin condition (twice per day is the recommendation of the British guideline) and the prevention of risk factors such as malnutrition or urinary incontinence.
c. Delirium: haloperidol 1.5 mg/day is recommended by the British guideline and the Scottish guideline recommends the good control of the main vital signs and the balance of fluid levels to prevent the delirium.
d. Constipation: the preventive actions recommended are early mobilization, good hydration, fiber intake and osmotic laxatives when necessary.
e. Oxygen supplementation to prevent heart problems: mainly during the first six to seventy two hours after surgery.

5. Time to surgery: within the first 24 hours (NZGC 2003 and SIGN 2009), within 14 to 36 hours (SEGG-SECOT 2007) and within 48 hours (BOA-BGS 2007)
6. Early mobilization: sitting and weight bearing as tolerate within 24 hours after surgery but with some exceptions depending of the patients and the result of the surgery.
7. Treatment of common clinical problems:
    a. Anaemia: the blood transfusion is not recommended if the hemoglobin level are >10g/dl
    b. Pain: it is very important the individual evaluation. All the guidelines recommended the prescription of paracetamol and if it is necessary the use of some minor opiates and even the use of morphine in some cases to avoid the pain.

c. Malnutrition: the common use of nutritional supplements are recommended for all the guides.

8. Coordinated treatment between orthopedic surgeons and geriatricians

Even when the recommendations of the guidelines are quite clear, the differences on the outcomes after a hip fracture continue to be large between countries and between services. The best cares after a hip fracture is currently a relevant topic for research. The evidence shows that units which combine orthopedic and geriatric work are the best at treating this patients (Stenvall et al. 2007, Neuman et al. 2009, Mak et al. 2010, Adunsky et al. 2011, Giusti et al 2011, Hung et al. 2012). The main characteristics of the new model of cares for patients with hip fracture are the following:

a. The co-managed care by orthopedic surgeons and geriatricians in spite of the conventional units where the professional who retained the responsibility of the care during the acute and post-acute phases was an orthopaedic surgeon. Patients treated by this model are considered as complex patients in whom the fracture can be a time of great risk for loss of independence and even death, rather a simple orthopaedic fracture subject (Giusti et al. 2011).

b. The staff works in teams to apply comprehensive geriatric assessments and rehabilitation (Stenvall et al. 2007, Mak et al. 2010, Hung et al. 2012). The staff working in the new models of care are: certified internists and geriatricians, orthopaedic surgeons, nurses, physioterapists, occupational therapists, social workers and psychologists (Adunsky et al. 2011).

c. Surgery within 36 hours of admission (Mak et al 2010, Hung et al. 2012). Early surgery , within 24 hours (Hommel et al. 2008, Verbeek et al. 2008, Sund et al. 2009), or within 48 hours (Novack et al. 2007, Rae et al. 2007, Harris et al. 2010, Carretta et al. 2011) is associated with reduced length of stay in hospital. The association with mortality is not clear. Some studies showed a positive association with mortality (Johansen et al. 2010, Carretta et al. 2011, Castronuovo et al. 2011, Pioli et al. 2011, Vochteloo et al. 2011, Gonzalez-Rozas et al. 2012), being even more important for patients with a poor functional status (Pioli et al. 2012), while other studies did not find association between time to surgery and mortality (Hommel et al. 2008, Smektala et al. 2008, Verbeek et al. 2008).

d. Active prevention, detection and treatment of postoperative complications (Mak et al 2010, Hung et al. 2012). The main cares are: Preoperative antibiotic prophylaxis; Use of spinal or epidural anaesthesia; Pharmacological deep venous thrombosis prophylaxis; Nutritional consultation or protein supplementation; Routine skin care and pressure ulcer prevention; Postoperative pain management; Timing of postoperative discontinuation of urinary catheters. These recommendations were associated with lower odds of four common complications of hospitalization after hip fracture (deep venous thrombosis, pressure ulcer, surgical site infection, urinary tract infection) but not associated with shot-term mortality (Neuman et al. 2009).

e. Early mobilization and daily training (physioterapists, occupational therapists and care staff). We cannot build detailed evidence-based exercise programs, because there are few authoritative studies about the role of early physical exercise programs. However the main recommendations (Di Monaco 2011, Sherrington et al 2011) are: Early assisted ambulation, early strength training

with preferential involvement in functional tasks, upper body endurance exercises, WB (Barone et al. 2009, Wu et al. 2009, Adunsky et al. 2001) and balance exercises performed for longer periods (Di Monaco 2011, Sherrington et al. 2011).

3.

Background and justification

Hip fracture is a major public health problem in the elderly because of its high incidence, the high related mortality and morbidity, the loss of functional independence, and the burden of care involved (Rosell et al. 2003, Kristensen et al. 2010, Ziden et al. 2010, Dhanwal et al.2011, Kristensen 2011, Serling et al. 2011)

In Spain, the incidence of hip fracture is higher than 100 per 100.000 inhabitants per year, and more than 500 per 100.000 in elderly people, (Alvarez-Nebreda et al. 2008). As a result of an increase in the elderly population, the number of hip fractures is expected to rise and put significant strain on the provision of medical care.

In the EU the cost of the treatment is 25.000 million in addition to the 15.000 million for the care of the patients during their first year after the hip fracture. In Spain, in 2008, the cost of the hospitalizations in the National Health System due to the hip fractures was 395.7 million euros (httsps.es/estadEstudios/estadisticas/cmbdhome.htm.).

When elderly people have a hip fracture, they are considered as special orthopaedic patients due to the number of comorbidities (Haentjenset al. 2005, Adunsky et al. 2008, Bergeron et al. 2009, Pioli et al. 2011), and the high surgery risk (Alarcon et al. 2011) that they display. A hip fracture in this population can often lead to the death of the patient.

The increased risk of death after hip fracture has been amply shown in the bibliography, with 1 year mortality ranging from 22-30% in European countries (Haleem et al. 2008, Castronuovo et al. 2011, Pioli et al. 2011, Tarazona-Santabalbina et al. 2012).

Elderly patients who survive a hip fracture usually suffer a loss of quality of life. Only a third of patients recover their previous level of activities of daily living (ADL) at one year

following a hip fracture (Candel-Parra et al. 2008, Penrod et al. 2008, Bentler et al. 2009), and the risk of the loss of previous social setting is high due to the high likelihood of a change in their place of residence (Johansen et al. 2010, Harris et al. 2010). The change of residence involves a decrease in social relationships, that seems larger after having a hip fracture as compared to other fracture types in elderly (Chiu et al. 2012). Due to the loss of their previous level of autonomy, these patients will require the presence of a caregiver to help them with everyday tasks.

Several efforts have been carried out to find the associated factors with mortality and functional outcomes, in order to design better strategies for the treatment of these patients. However, the influence of some of these factors continues to be unclear, and new strategies of treatment have not fully resolved the high mortality and the loss of function, though they have reduced them.

In Spain, to our knowledge, there are few recent studies (Candel-Parra et al. 2008, Alarcon et al. 2011, Montalbán-Quesada et al. 2012, Tarazona-Santabalbina et al. 2012) about the topic, and these few studies show important limitations due to short follow up times (Candel-Parra et al. 2008, Montalbán-Quesada et al. 2012, Tarazona-Santabalbina et al. 2012,), the study of a small number of functional activities (Rodriguez-Fernandez et al. 2011, Ortiz-Alonso et al. 2012, Tarazona-Santabalbina et al. 2012), or the study of short-term mortality (Librero et al. 2012). The compliance of the clinical guidelines is another issue that has not been considered in these studies, and it would be interesting to know if the health care providers in Spain are following the recommendations of the guidelines and the best practices as written in the literature.

The loss of function and the high likelihood of mortality even one year after the fracture show the need for new strategies of treatment for these patients.

4.

Objetivos

Objetivo General

El principal objetivo de esta tesis fue determinar el nivel funcional, la mortalidad, y los factores relacionados con la funcionalidad y la mortalidad, durante el primer año posterior a la intervención quirúrgica de una fractura de cadera.

Objetivos Específicos

1. Describir la evolución de la recuperación funcional analizando dieciocho actividades de la vida diaria, al mes, tres meses, y al año de la intervención quirúrgica de la fractura de cadera.

2. Analizar el cambio de residencia tras una fractura de cadera quirúrgica.

3. Examinar la influencia del apoyo precoz del miembro operado en el nivel de funcionalidad, a los tres meses y al año de la intervención quirúrgica.

4. Identificar la mortalidad y los factores de riesgo de mortalidad durante el primer año en pacientes con fractura de cadera quirúrgica.

General Objective

The overall aims of this thesis were to determine the functional outcomes, the mortality, and the factors influencing these outcomes within one year after hip fracture surgery.

Specific objectives

5. To describe the time-line to recovery of function in terms of eighteen Activities of Daily Living items at one month, three months, and one year after hip fracture surgery.

6. To look into the change of residence after hip fracture surgery.

7. To examine the influence of WB status after hip fracture surgery on the functional outcome at three months and one year.

8. To identify the mortality and risk factors in elderly patients with hip fracture during the first year after surgery.

5.

Patients and Methods

5.1. Study design

This was a prospective observational cohort study carried out between February 2009 and January 2010, at the Traumatology Service Hospital of Jaen which covers a population of more than 281.034 inhabitants who live in the city of Jaen and 31 villages of the region. Jaen is a region of the south of Andalusia with 670.600 people (333.384 men and 337.216 women) (Data for January 1st of 2011 available in http://www.ine.es/jaxi/tabla.do. View in July 29th 2013). The reference area of the Hospital of Jaen covers health centers in the districts of Jaen and South of Jaen. The traumatology service has 68 beds for adults. For a description of the service visit the web site: (http://www.juntadeandalucia.es/servicioandaluzdesalud/chjindex.php?id=200&nv=3&nv2=21&nv3=269).

5.2. Patients

Participants included in this study were people with an acute hip fracture admitted consecutively at the Hospital of Jaen, who met the following inclusion criteria:

- Aged 65 years and older
- Having surgery after the hip fracture
- Surviving the first 24 hours after surgery
- Absence of terminal disease
- Six months or more living in the Jaen region.
- Accept to participate and signed an informed consent.

5.3. Follow up

Participants in the study were all the patients who met the inclusion criteria within one year, between February 2009 and January 2010, and the patients were followed for one year after surgery.

5.4. Sources of information

The sources of information used were:

- Interviews with the patient, their relatives or their caregiver. The first interview took place during the hospital stay after surgery while the second (at one month) and third (at three months) interviews were at the hospital coinciding with Traumatology revisits. The last interview (at one year) was done by telephone. Information was collected through a structured face-to-face interview, managed by one experienced therapist-interviewer.

- The Medical Record of the patients was usually reviewed on the day of the interview.

5.5. Study variables

5.5.1. Outcome measures

- ***Functional level***

The functional level at one month, three months and one year after surgery was assessed by the Functional Independence Measure (FIM) (Ottenbacher et al. 1996).

The FIM has six categories with a total of eighteen items, thirteen of them corresponding to physical domains and five to cognitive ones. The items, scored according to the level of assistance required for an individual to perform activities of daily living, are:

1) *Self-care*: eating, grooming, bathing/showering, dressing upper body, dressing lower body, and toileting
2) *Sphincter Control*: bladder management, and bowel control
3) *Mobility*: transfer bed-chair-wheelchair, transfer toilet, and transfer bathtub-shower
4) *Locomotion*: walking-wheelchair, and stairs
5) *Communication*: expression, and comprehension
6) *Cognition-Problem solving*: social interaction, problem solving, and memory.

Each item is scored from 1 to 7 based on the level of independence, where each score represents the following:

- 1 point; total dependence
- 2 points; maximum assistance from another person (subject provides less than half of the effort)
- 3 points; moderate assistance from another person (subject performs 50%-75% of the task)
- 4 points; minimum assistance requiring incidental hands-on help only (subject performs >75% of the task)
- 5 poins; supervision requiring only standby assistance or verbal prompting or help with set-up
- 6 points; modified independence (subject requires the use of technical assistance but no physical help)
- 7 points; indicates complete independence.

FIM total scores range from 18 to 126 points, the higher scores indicating a higher level of independence. The FIM is well validated for patients with hip fracture (Ottenbacher et al. 1996) and during stroke rehabilitation (Gialanella et al. 2012). The median reliability values for the FIM total score was 0.95. For the six FIM subscales the median reliability values ranged from 0.95 for Self-Care to 0.78 for Social Cognition. For the eighteen FIM items, median reliability values varied from 0.90 for Toilet Transfer to 0.61 for Comprehension (Ottenbacher et al. 1996).

Based on the FIM total score, we constructed a new variable to categorize the level of independence as either need for some type of personal assistance for FIM values from 18 to 90 (assuming a score of 5 or below for each item of the scale) or independent, when FIM values were between 91 and 126 (a score of six or seven for each item).

- ***Mortality***

Days to mortality from surgery was obtained from the interview with the relatives and from the patient´s medical records.

5.5.2. Exposure variables

- *Sociodemographic data:*
    - Age (obtained from the medical record)
    - Sex; classified as man or woman

- Educational level; categorized as 1) person who does not know how to write and read, 2) person can write and read, 3) Primary school, 4) High school, 5) college or university (asked during the interview).

- Prefracture residential status; categorized as 1) own home and live alone, 2) own home and do not live alone, 3) home of a relative and 4) nursing home. We recoded this variable as 1) relatives or own home, and 2) nursing home (collected during the interview) in study about mortality.

- Discharge destination; classified as 1) own home and live alone, 2) own home and not live alone, 3) home of a relative and 4) nursing home. We recoded this variable as 1) relatives or own home, and 2) nursing home (collected during the interview) in study about mortality.

- *Clinical data of the patients*:

  - Weight (kilograms) and Height (centimeters), used to calculate the body mass index.

  - The cognitive status; was assessed by the Pfeiffer Scale (Pfeiffer 1975) and was categorized as light or no cognitive impairment (0-4) and severe cognitive impairment (5-10) (obtained during the interview)

The Pffeifer Scale is a 10-item test used to detect and determine the presence and the degree of cognitive impairment. The concepts measured include: orientation, memory function related to capacity for self-care, remote memory, and capacity to perform several mental operations.

The 4 distinct levels of intellectual functioning are: 1) intact intellectual functioning (0-2 errors), 2) mild intellectual impairment (3-4 errors), 3) moderate intellectual impairment (5-7 errors), and 4) severe intellectual impairment (8-10 errors). The scores have been influenced by the educational levels. That is, those with lower educational levels tend to make one more error. This test demonstrated a high relative reliability and validity (Pfeiffer 1975). Test-retest correlation was 0.82 for outpatient elderly and 0.83 for institutional elderly at four-week intervals. A 92% agreement was shown between the scale score and the clinical diagnosis when the scale indicated definite impairment, and 82% of agreement when the scale indicated either no impairment or only mild impairment (Pfeiffer 1975).

- Surgery risk/health status was assessed using the American Society of Anaesthesiologists (ASA) rating (collected from the medical record)

The American Society of Anaesthesiologists (ASA) rating (Owens et al. 1978) is a classification system initially created in 1941 by the American Society of Anaesthetists, an organization that later became the ASA.

The purpose of the grading system was simply to assess the degree of a patient's "sickness" or "physical state" prior to selecting the anaesthetic or prior to performing surgery (Rauh et al. 2004). The modern classification system consists of five categories:

ASA 1 - A normal healthy patient

ASA 2 - A patient with mild systemic disease

ASA 3 - A patient with severe systemic disease

ASA 4 - A patient with severe systemic disease that is a constant threat to life

ASA 5 - A moribund patient who is not expected to survive without the operation

We categorized this variable as high health status (scores of 1-2) and low health status (scores of 3-5).

- Comorbidity was assessed by the Charlson index (Charlson et al. 1987 (obtained from the medical record)

The Charlson Comorbidity Index is a prognostic Index proposed by Mary Charlson et al in 1987 as a means for quantifying the prognosis of patients enrolled in clinical trials. It is a tool used to assess probable mortality for patients with multiple serious illnesses. This index predicts the ten-year mortality for a patient who may have a range of co-morbid conditions. Each condition (19 items) is assigned with a score of 1,2,3 or 6 depending on the risk of dying associated with this condition. Higher scores indicate greater comorbidity. This test has been well validated in the literature (Charlson et al. 1987, Sundararajan et al. 2004)

- *Clinical and treatment data related with the hip fracture:*
  - Type of fracture; classified as intracapsular (cervical) or extracapsular (trochanteric) (collected from the medical score)
  - Type of surgery; categorized as 1) hemiarthroplasty, 2) Dynamic hip screw with plate and 3) Intra medulla hip screw (obtained from the medical score)
  - Length of hospital stay; (collected from the medical record)
  - Time from admission to surgery; (obtained from the medical record)
  - Medical or surgical complications; filed as 1) yes (when a patient had at least one of the following complications: nosocomial infection, pressure

ulcer, delirium or resurgery) or 2) none. (This variable was collected from the medical record and the interviews).

- Place of the fall; categorized as indoor or outdoor (asked during the interview)
- Rehabilitation sessions at hospital (collected from the medical record)
- Rehabilitation session after discharge (asked during the follow-up interviews)

- *Functional Characteristics:*
  - The prefracture functional level was measured by the Functional Independence Measure (FIM). This scale was filled during the first interview done at the hospital within the first week after surgery. The patients were asked about their functional level before the fracture.
  - Aid at discharge; classified as 1) wheelchair, 2) walker and 3) crutches (collected from the medical record and the interviews)
  - Assistance at discharge; categorized as 1) Looked after by a formal caregiver or 2) looked after by an informal caregiver (relatives) (obtained during the interviews)
  - The WB status of all patients was decided by the orthopedic surgeons at the hospital as either 1) allowed full WB (practiced as WBAT) 48 hours after surgery, or 2) not allowed any WB for the first two to four weeks after surgery. This variable was obtained from the medical record and from the interviews.

We developed a questionnaire to collect the data (Annex 2).

5.6. Ethical issues

This study was approved by the ethics committee of the Hospital of Jaen before data collection.

All patients included in the study read the study information paper and signed an informed consent (Annex 1) the same day that they had the first interview (within the first week after surgery). For patients with cognitive impairment, the closest relative or caregiver signed the informed consent.

5.7. Data analyses

Data were examined for normality of distribution with the Kolmogórov-Smirnov test, and presented as absolute frequencies for qualitative variables, as means (with standard deviation) or as median (with first and third quartiles), as appropriate, for continuous variables. A two-sided probability level of 0.05 or less was deemed to indicate statistical significance. Data were analyzed using the statistical programme SPSS Version 15.0.

Below are described the study objectives and the data analysis techniques employed to achieve each objective.

Objective 1: To describe the recovery of function in terms of 18 ADL items at one month, three months, and one year after hip fracture surgery.

A comparison of the FIM total and the six categories at the different time points from pre-surgery to one year after surgery was done using the Friedman test for repeated measures of non-parametric data. If significant, the Wilcoxon test was performed to

examine differences, with Bonferroni adjustments to minimize the risk of Type 1 error; this gave a P value of $P<0.01$ for the five comparisons ($P<0.05/5=0.01$). In addition, the proportion of patients who recovered their pre-fracture functional level was calculated, with the pre-fracture level set at 100%. Finally, we calculated the change in the number of patients able to function without assistance from another person (scoring 6 or 7) when performing specific items.

Objective 2: To look into the change of residence after hip fracture surgery.

Data are presented as number of patients (with percentage) comparing the status of residence before and after fracture.

Objective 3: To examine the influence of WB status after hip fracture surgery to the 3-months and 1-year functional outcome.

The characteristics and outcome of WB and NWB groups were compared using Chi-square test for categorical variable; the Mann-Whitney U test was used for quantitative variables. For each group, the Friedman test was used to analyse the influence of WB status on the FIM evolution from pre-fracture to 1 year, while the Mann-Whitney U test was used to evaluate differences between the two groups at the three follow-up time-points (1 month, 3 months and 1 year). Simple and multiple linear regression analyses were used to examine the influence of WB status in addition to other predictor variables to the functional level at 3 months and 1 year after hip fracture surgery, to establish unadjusted (crude) and adjusted Beta-values.

The variables included in the adjusted analysis were selected using epidemiologic criteria.

Reference categories used in multiple linear regression analyses were: female sex, prefracture functional level (high), cognitive status (no cognitive impairment), high health status (ASA rating 1-2), prefracture residence (own home), rehabilitation after discharge (no), cervical fracture, and WB (allowed), while age was entered as a continuous variable.

Objective 4: To identify the one year mortality and predisposing factors in elderly patients with hip fracture during the first year after surgery

Kaplan-Meier survival analysis was used to calculate the cumulative survival probability up to one year from surgery. The significance of the differences was evaluated using the log-rank test and the Breslow test when appropriate. Cox regression models (unadjusted and adjusted) were performed to analyse the associated factors to mortality. The selection of co-variables was done using epidemiological criteria. The reference categories were: women, no cognitive impairment (Pfeiffer score 0-4), high prefracture functional level (FIM score 91-126), allowed WB, intracapsular fracture, continue living with relatives or own home. Age (years) and comorbidity (Charlson index score) were entered as continuous variables. Adjusted Hazard ratios (HZ) and 95% confidence intervals (CIs) were calculated.

6.

Results

6.1. Description of the cohort

A total of 343 patients were admitted at the hospital with a hip fracture between February the 1st of 2009 and January the 31st of 2010, of which 275 patients were included for final analysis (figure 7).

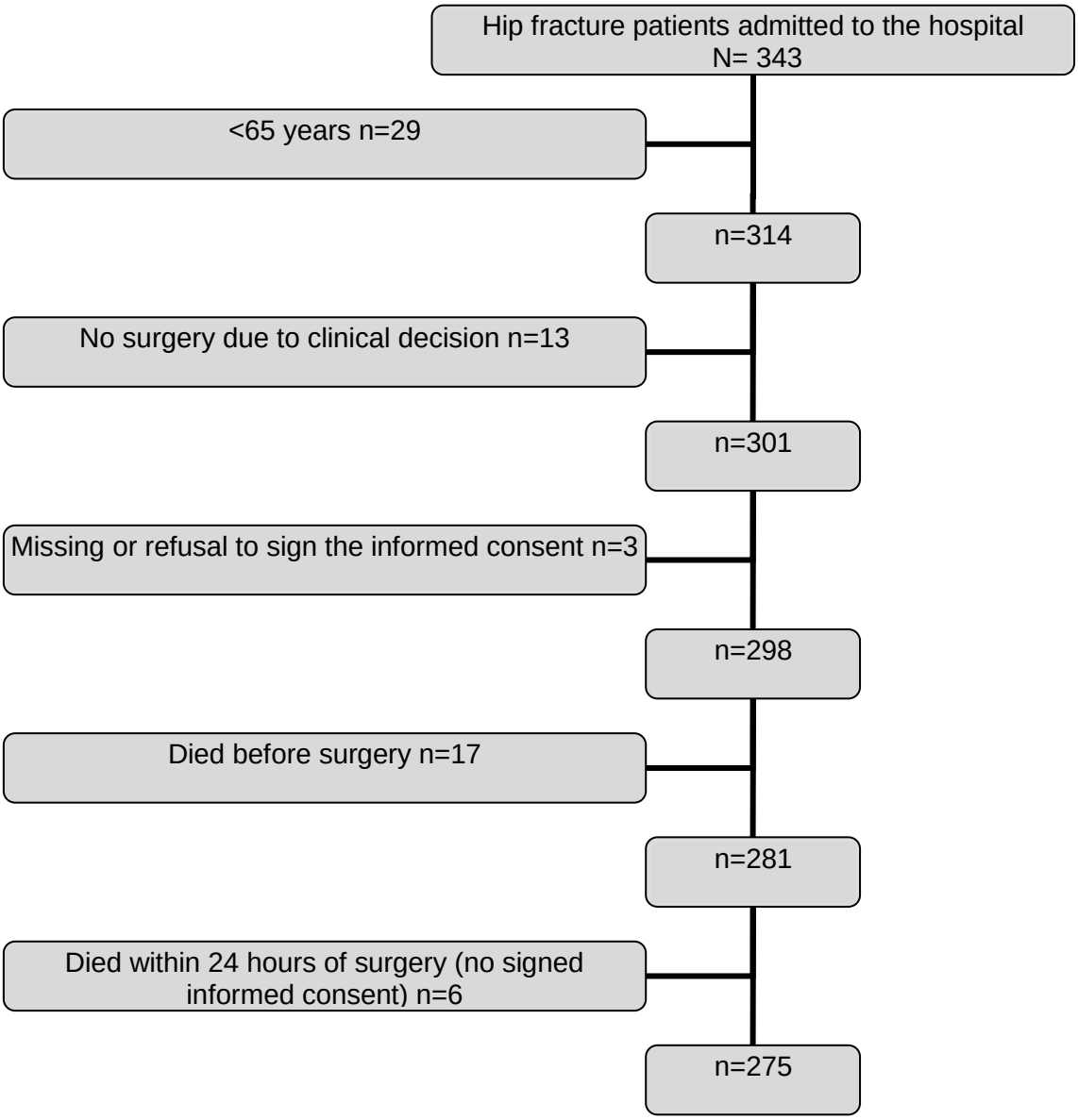

Figure 7. Flow chart of patients.

The mean age of the 275 patients finally included in the study was 81.4 (SD 6.8) years, 216 (79%) of whom were women. Most of these patients, 201 (73%), had a high pre-fracture functional level, and 174 (63%) had no cognitive impairment. The rest of the baseline demographic, clinical, and functional data are shown in tables 2 to 5.

Table 2. Demographic data.

Variables	Categories	N = 275
Mean **Age** in years (SD)		81.4 (6.8), 65–100
Sex	Women	216 (79)
	Men	59 (21)
Prefracture Residence	Relatives or Own home	239 (87)
	Nursery home	36 (13)
Residence at discharge	Relatives or Own home	215 (78)
	Nursery home	60 (22)
Changes in residence status	Relatives or Own home before and after	215 (78)
	Nursery home before and after	36 (13)
	Change of residence after hip fracture	24 (9)

Data are number with (percentage) or mean with (standard deviation), minimum-maximum.

Table3. Clinical Characteristics of the patients.

Variables	Categories	N = 275
Body Mass Index, n=273*	Normalweight	108 (40)
	Overweight	111 (40)
	Obese	54 (20)
Charlson Index n=272*****	Score	6 (5–7)
American Society of Anaesthesiologists score (ASA) n=272*	High Health Status (1-2)	99 (36)
	Low Health Status (3-5)	173 (64)
Cognitive impairment (Pfeiffer)	No Cognitive impairment (Pfeiffer; 0-4)	174 (63)
	Cognitive impairment (Pfeiffer ≥5)	101 (37)

Data are number with (percentage) or median (25-75%, quartiles). *Due to missing data.

Table 4. Clinical Characteristics related with the hip fracture.

Variables	Categories	N = 275
Place of the fall n=247*	Indoor	196 (79)
	Outdoor	51 (21)
Type of fracture n=272*	Intracapsular fracture	129 (47)
	Extracapsular fracture	143 (53)
Type of surgery n=272*	Hemiarthroplasty	93 (34)
	Dynamic Hip Screw with plate	133 (49)
	Intra Medullar Hip Screw	46 (17)
Time from admission to surgery	Within 24 hours	134 (49)
	Later than 24 hours	141 (51)
Length of hospital stay in days		11 (7–18)

Data are number with (percentage) or median (25-75%, quartiles). *Due to missing data.

Table 5. Functional Characteristics.

Variables	Categories	N = 275
Prefracture Functional Level (FIM)	Low Prefracture functional level (18-90)	74 (27)
	High Prefracture functional level (91-126)	201 (73)
Aid at discharge	Wheelchair	97 (36)
	Walker	171 (63)
	Crutches	3 (1)
Assistance at discharge, n=270*	Formal caregiver	75 (28)
	Informal caregiver (family)	195 (72)
Rehabilitation sessions at hospital		4 (2-5)
Rehabilitation sessions within 3 months of discharge, n=246*	Yes	169 (69)
	No	77 (31)

Data are number with (percentage) or median (25-75%, quartiles). *Due to missing data.

6.2. Functional recovery

6.2.1. All patients

One year after the surgery, a total of 25 patients (11.5%) fully regained the same FIM score that they had before the hip fracture. The corresponding proportion at three months after surgery was 7%.

Scores for the total FIM and the six categories for patients alive at the different time points from pre-fracture to the one year follow-up showed that the total FIM score decreased from a median of 111 (87-123) (25-75%, quartiles respectively) points to 77 (52-95) at one month, then increased to medians of 93 (59-110) and 100 (70-116)

points at three months and 1 year, respectively. The “locomotion”, “mobility” and “self care” categories were the most significantly affected at one year (Table 6, Figure 8 and 9).

Repeated measures analysis showed significant differences ($p<0.01$) for total FIM scores: pre-fracture to one month, prefracture to three months, prefracture to one year, one to three months and three months to one year. Moreover, significant differences were seen for the categories self care, mobility and locomotion, for the same comparisons as above (Table 6).

Although the capacity for locomotion was the most affected at short term —with a 58% loss of capacity at one month and 42% at the three month follow-up— this was the area where the greatest recovery was seen after one year (Table 6). The corresponding values for self care showed 38%, 21% and 15%, respectively ($p<0.001$), and for mobility were 53%, 26%, and 16% ($p<0.001$) (Table 6).

Still, dressing lower body, transfer bathtub/shower and walking stairs were only fully recovered for 57%, 67% and 67%, respectively, at one year (Table 6)

Table 6. Recovery of Function using the Total Functional Independence Measure (FIM) and for each item from pre-fracture to one year after hip fracture.

	Pre-fracture N=275	1-Month N=262	3-Months N=248	1-Year N=221
Total FIM (18-126)*#	111(87-123)	77(52-95);69†	93(59-110); 83‡	100(70-116); 90$
Self care (6-42)*#	39(30-42)	24(13-32); 62	31(18-37); 79	33(23-39); 85
Eating	7(7-7)	7(4-7)	7(5-7)	7(6-7)
Grooming	7(6-7)	5(2-7); 71	6(4-7); 86	7(4-7)
Bathing/Showering	5(3-7)	2(1-3); 40	3(2-5); 60	4(2-6); 80
Dressing upper body	7(5-7)	4(2-7); 57	6(3-7); 86	6(4-7); 86
Dressing lower body	7(4-7)	2(1-4); 29	4(2-6); 57	4(3-7); 57
Toileting	7(6-7)	3(1-6); 43	6(2-6); 86	6(3-6); 86
Sphincter Control (2-14)*	12(9-14)	10(7-14); 83†	11(7-14); 92‡	11(9-14); 92$
Bladder management	5(3-7)	4(2-7); 80	4(2-7); 80	5(2-7)
Bowel management	7(6-7)	7(5-7)	7(6-7)	7(6-7)
Mobility (3-21)*#	19(15-21)	9(4-13); 47	14(7-17); 74	16(10-18); 84
Transfer bed/chair	7(6-7)	3(2-5); 43	5(3-6); 71	6(4-6); 86
Transfer toilet	7(6-7)	3(1-6); 43	6(3-6); 86	6(4-6); 86
Transfer bathtub/shower	6(3-7)	2(1-3); 33	3(2-5); 50	4(2-6); 67
Locomotion (2-14)*#	12(8-14)	5(2-7); 42	7(5-11); 58	10(6-12); 83
Walking/Wheelchair	7(6-7)	4(1-6); 57	6(4-6); 86	6(5-6); 86
Stairs	6(2-7)	1(1-1); 17	2(1-5); 33	4(1-6); 67
Communication (2-14)	13(10-14)	13(9-14)	13(9-14)	13(10-14)
Understanding	7(5-7)	7(5-7)	7(5-7)	7(5-7)
Expression	6(5-7)	6(4-7)	6(4-7)	6(5-7)
Cognition (3-21)*	19(13-21)	18(11-21); 95) †	18(11-21); 95‡	18(12-21); 95$
Social interaction	7(6-7)	7(6-7)	7(5-7)	7(6-7)
Problem solving	6(2-7)	5(1-7); 83	5(1-7); 83	5(1-7); 83
Memory	7(5-7)	6(4-7); 86	6(4-7); 86	6(4-7); 86

Data are presented as median with (25-75%, quartiles); and percentage of the pre-fracture level, (e.g. one month/pre-fracture) x 100.

*Friedman repeated measures analysis; P<0.001. Wilcoxon with Bonferroni corrections p<0.01; #All the following comparisons, †Pre-fracture/1Month, ‡Pre-fracture/3Months, $Pre-fracture/1Year, 1Month/3Months, 3Months/1Year.

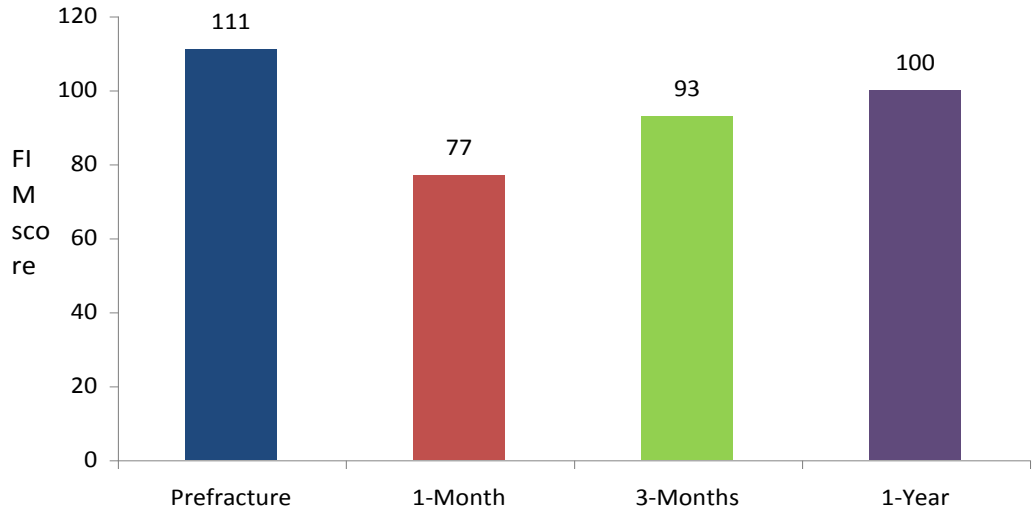

Figure 8. Evolution of median score of Functional Independence Measure

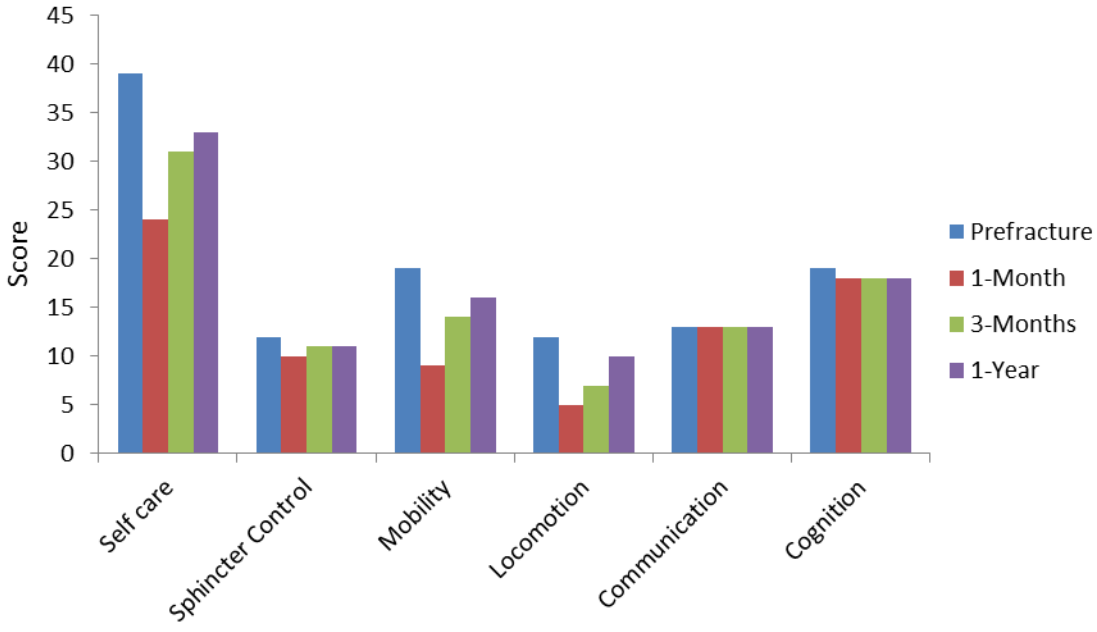

Figure 9. Evolution of median score of self care, sphincter control, mobility, locomotion, communication and cognition.

6.2.2. Patients allowed weight bearing

In order to evaluate the outcome of patients not restricted in early mobilization, the patients included in our study of 'time to recovery of the function after a hip fracture' met the following criteria: 1) Being 65 years or older; 2) Accepting to participate in the study, signing an informed consent form; 3) Allowed weight-bearing as tolerated after surgery; and 4) Absence of a terminal disease. A total of 178 patients with hip fracture fulfilled the inclusion criteria, of which six died immediately after surgery, and data on 13 patients was not available, leaving 159 patients for inclusion in the study (First paper: "Change of residence and functional status within three months and one year following hip fracture surgery". Published in *Disability and Rehabilitation* and included as Annex 4).

Characteristics of the 159 patients (120 women, 76%) with a mean age of 81.2 (6.6) years are presented in Table 7. Five patients died within the first month after surgery, seven between the first and the third month, and 10 between the third month and the first year. Moreover, one patient was lost after the third month, leaving 135 elderly patients to be followed during the entire study period of one year.

Table 7. Demographic and Clinical Characteristics of Patients.

Variables	Categories	N = 159
Mean Age in years (SD)		81.2 (6.6), 65–100
Sex	Female	120 (76)
Residence before fracture	Presented in Table 15	
Body Mass Index, n=158*	$\leq$ 25 kg/m^2	69 (43)
	> 25 kg/m^2	89 (56)
American Society of Anaesthesiologists score	1 or 2 = high health status	60 (38)
	3-5 = low health status	99 (62)
Pfeiffer score (cognitive), n=145*	0-4 = No impairment	106 (67)
	≥ 5 Moderate to high impairment	39 (24)
Place of the fall, n=147*	Indoor	110 (69)
	Outdoor	37 (23)
Type of fracture	Intracapsular fracture	95 (60)
	Extracapsular intertrochanteric	54 (34)
	Extracapsular subtrochanteric	10 (6)
Time from admission to surgery	Within 24 hours	84 (53)
	Later than 24 hours	75 (47)
Type of surgery	Hemiarthroplasty	76 (48)
	Dynamic Hip Screw with plate	70 (44)
	Intra Medullar Hip Screw	13 (8)
Length of hospital stay in days		13.5 (10.4), 5-94
Aid at discharge	Wheelchair	4 (3)
	Walker	153 (96)
	Crutches	2 (1)
Discharge destination	Own home not alone	92 (58)
	Relative's home	42 (26)
	Nursing home	25 (16)
Assistance at discharge, n=157*	Formal caregiver	38 (24)
	Informal caregiver (family)	119 (76)
Rehabilitation sessions within 3 months of discharge, n=145*	Yes	94 (65)
	No	51 (35)

Data are number with (percentage) or mean with (standard deviation), range. *Due to missing data.

Scores for the total FIM and the six categories for patients alive at the different time points from pre-fracture to the one year follow-up showed that the total FIM score decreased from a median of 114 (94-124) points to 89 (60-101) at one month, then increased to medians of 99 and 105 points at three months and 1 year, respectively. The “mobility” category was the most significantly affected for the patients allowed weight bearing (Table 8).

Table 8. Evolution of the Total Functional Independence Measure (FIM) and for Each of the Six Categories, from Pre-fracture to One-Year after Hip Fracture.

	Pre-fracture N = 159	1-Month n = 154	3-Months n = 147	1-Year n = 135
Total FIM (18-126)	114 (94 – 124)	89 (60 – 101)	99 (72 – 115)	105 (82 – 118)
Self care (6-42)	40 (33 – 42)	28 (17 – 33)	33 (23 – 38)	34 (28 – 40)
Sphincter Control (2-14)	12 (9 – 14)	11 (8 – 14)	12 (9 – 14)	12 (9 – 14)
Mobility (3-21)	20 (15 – 21)	11 (6 – 14)	15 (11 – 17)	16 (13 – 18)
Locomotion (2-14)	12 (9 – 14)	3 (6 – 18)	9 (6 – 12)	11 (7 – 13)
Communication (2-14)	14 (10 – 14)	13 (10 – 14)	13 (11 – 14)	13 (11 – 14)
Cognition (3-21)	20 (15 – 21)	19 (13 – 21)	19 (13 – 21)	19 (1 – 21)

Data are presented as median with (25-75% quartiles)

Repeated measures analysis showed significant differences ($p<0.001$) for total FIM scores: pre-fracture to one month, pre-fracture to three months, pre-fracture to one year, one to three months and three months to one year (Table 9). Moreover, significant differences were seen for the categories self-care, mobility and locomotion, for the same comparisons as above (Table 9).

Table 9. Recovery of Function for Patients Alive at One Year (n=135).

	Pre-fracture	1-Month	3-Months	1-Year
Total FIM (18-126)*#	115 (98-125)	90 (65-102);78†	100 (79-115);87‡	105 (82-118); 91$
Self care (6-42)*#	40 (35-42)	29 (20-34); 73	33 (26-38); 83	34 (28-40); 85
Eating	7 (7-7)	7 (6-7)	7 (7-7)	7 (7-7)
Grooming	7 (7-7)	6 (4-7); 86	7 (4-7)	7 (5-7)
Bathing/Showering	6 (3-7)	2 (2-3); 33	3 (2-3); 50	4 (3-6); 67
Dressing upper body	7 (6-4)	6 (3-7); 86	6 (4-7); 86	6 (4-7); 86
Dressing lower body	7 (5-7)	3 (2-4); 43	4 (3-6); 57	4 (4-7); 57
Toileting	7 (6-7)	5 (2-6); 71	6 (4-6); 86	6 (5-6); 86
Sphincter Control(2-14)*	13 (10-14)	12 (9-14); 92†	12 (9-14); 92‡	12 (9-14); 92$
Bladder management	6 (3-7)	5 (3-7); 83	5 (3-7); 83	5 (3-7); 83
Bowel management	7 (6-7)	7 (6-7)	7 (6-7)	7 (6-7)
Mobility (3-21)*#	20 (16-21)	12 (8-15); 60	15 (12-17); 75	16 (13-18); 80
Transfer bed/chair	7 (6-7)	4 (3-6); 57	6 (4-6); 86	6 (5-6); 86
Transfer toilet	7 (6-7)	5 (3-6); 71	6 (4-6); 86	6 (5-6); 86
Transfer bathtub/shower	6 (4-7)	2 (2-3); 33	4 (2-5); 67	4 (3-6); 67
Locomotion (2-14)*#	12 (9-14)	6 (3-8); 50	9 (6-12); 75	11 (7-13); 92
Walking/Wheelchair	7 (6-7)	5 (3-6); 71	6 (5-6); 86	6 (5-7); 86
Stairs	6 (4-7)	1 (1-3); 17	4 (1-6); 67	5 (1-6); 83
Communication (2-14	14 (10-14)	14 (10-14)	13 (11-14); 93	13 (11-14); 93
Understanding	7 (6-7)	7 (6-7)	7 (6-7)	7 (6-7)
Expression	7 (5-7)	7 (5-7)	6 (5-7); 86	6 (5-7); 86
Cognition (3-21)*	20 (16-21)	20 (14-21) †	19 (14-21); 95‡	19 (13-21); 95$
Social interaction	7 (7-7)	7 (6-7)	7 (6-7)	7 (6-7)
Problem solving	7 (3-7)	6 (3-7); 86	6 (2-7); 86	6 (2-7); 86
Memory	7 (6-7)	7 (5-7)	7 (5-7)	7 (5-7)

Data are presented as median with (25-75%, quartiles); and percentage of the pre-fracture level, (e.g. one month/pre-fracture) x 100.

*Friedman repeated measures analysis; P<0.001. Wilcoxon with Bonferroni corrections p<0.01; #All the following comparisons, †Pre-fracture/1Month, ‡Pre-fracture/3Months, $Pre-fracture/1Year, 1Month/3Months, 3Months/1Year.

Although the capacity for locomotion was the most affected at short term —with a 50% loss of capacity at one month and 25% at the three month follow-up— this was the area where the greatest recovery was seen after one year (Table 9). The evolution of self-care showed 27%, 17% and 15%, respectively ($p<0.001$), and for mobility the values were 40%, 25%, and 20% ($p<0.001$) (Table 9).

It is noteworthy that the number of independent patients (scoring 6 or 7 points) from pre-fracture to one year post surgery dropped from 55% to 33% for bathing/showering, 73% to 42% for dressing lower body, 85% to 67% for toileting, 89% to 65% for transfer bed/chair, 85% to 67% for transfer toilet, 56% to 30% for transfer bathtub/shower, and from 67% to 43% for walking up/down stairs.

Patients who received outpatient rehabilitation within three months (n = 87, 64%), ranging from less than seven sessions (n = 9) to more than 21 (n = 30) had better FIM total scores at three months and at one year, with respective medians of 101 (86-116, $p=0.02$) and 107 (86-118, $p=0.06$), as opposed to those without rehabilitation, showing medians of 93 (61-113) and 95 (70-116).

6.2.3. Comparison between patients allowed and those not allowed weight-bearing

The loss of functional level was different for patients allowed weight bearing and those not allowed weight bearing after surgery. The figures 10 to 13 show the evolution of the scores for total FIM pre-fracture, at one month, three months and one year after surgery and for activities most affected (mobility, locomotion and self care) within the first year after surgery, comparing all patients, patients allowed WB and patients not

allowed WB. Tables 10 to 13 show the recovery (percentage) of the function at one month, three months and one year for the total FIM and the activities of mobility, locomotion and self care. Patients allowed WB had the main recovery within the first three months, while patients not allowed WB needed more time.

Figure 10. FIM total score median for all patients, patients allowed WB and patients not allowed WB.

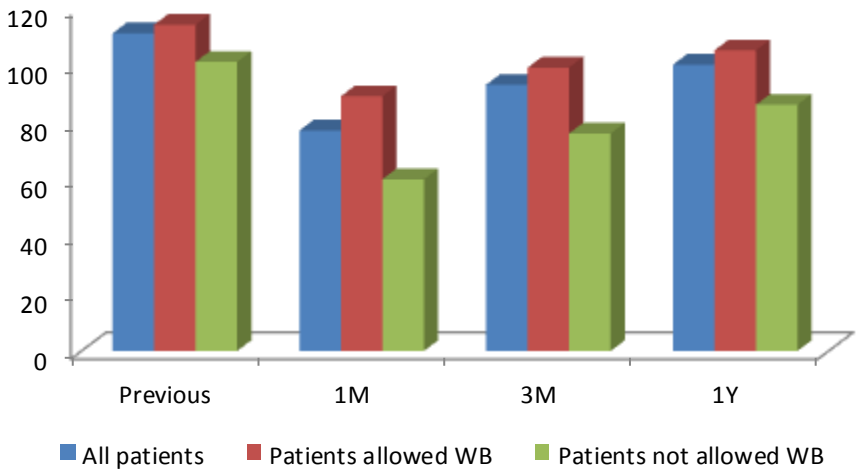

Table 10. Recovery of total FIM in percentage according to previous total FIM for patients alive at one year

	All patients n=221 Median (Q1,Q3)	Patients allowed WB* n=137 Median (Q1,Q3)	Patients not allowed WB** n=84 Median (Q1,Q3)	p- value
1-Month	74.6 (62.3–85.7)	79.5 (66.1–88.3)	66.7 (55.8–78.6)	<0.001
3-Months	87.3 (71.5–94.3)	90.2 (76.1–95.2)	81 (65.9–92.1)	<0.001
1-Year	91.9 (73.1–97.8)	92.9 (78.6–98.7)	87.6 (62.9–96.8)	0.001

*, ** Friedman test for WB and NWB groups <0.001

Figure 11. Mobility score median for all patients, patients allowed WB and patients not allowed WB.

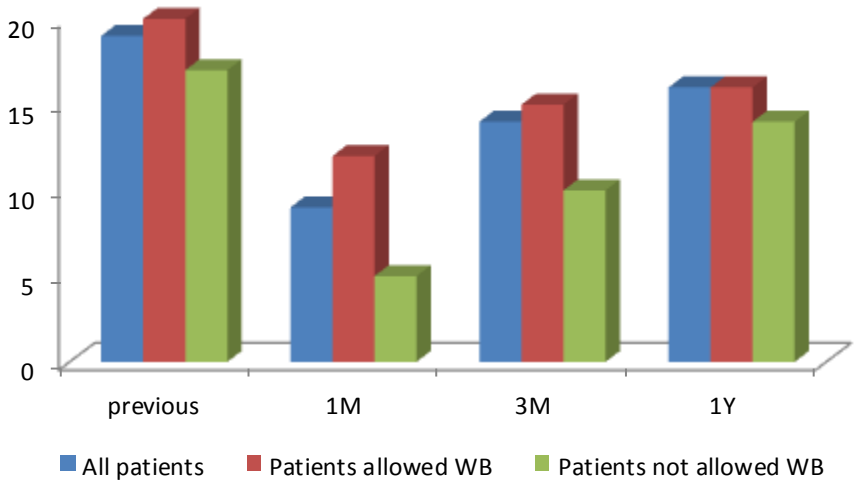

Table 11. Recovery of Mobility in percentage according to previous Mobility for patients alive at one year

	All patients n=221 Median (Q1,Q3)	Patients allowed WB* n=137 Median (Q1,Q3)	Patients not allowed WB** n=84 Median (Q1,Q3)	p- value
1-Month	54.5 (33.3–71.4)	61.9 (45.8–76.5)	36.3 (23.3–58.4)	<0.001
3-Months	76.2 (57.1–87.5)	78.9 (66.7–90.5)	67.5 (43.3–85.3)	<0.001
1-Year	81 (61.9–95.2)	85 (71.4–95.2)	76.2 (44.4–93.3)	<0.001

*, ** Friedman test for WB and NWB groups <0.001

Figure 12. Locomotion score median for all patients, patients allowed WB and patients not allowed WB.

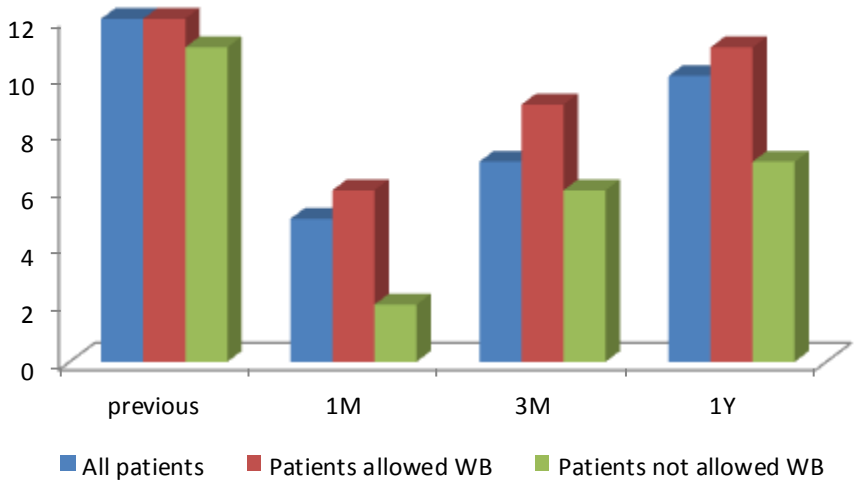

Table 12. Recovery of Locomotion in percentage according to previous Locomotion for patients alive at one year

	All patients n=221 Median (Q1,Q3)	Patients allowed WB* n=137 Median (Q1,Q3)	Patients not allowed WB** n=84 Median (Q1,Q3)	p- value
1-Month	50 (28.6–71.4)	53.8 (42.9–84)	28.6 (17–50)	<0.001
3-Months	76.9 (50–91.7)	84.6 (58.3–92.9)	66.7 (42.9–85.7)	<0.001
1-Year	85.7 (61.3–100)	85.7 (70.3–100)	81.7 (50–100)	<0.001

*, ** Friedman test for WB and NWB groups <0.001

Figure 13. Self care score median for all patients, patients allowed WB and patients not allowed WB.

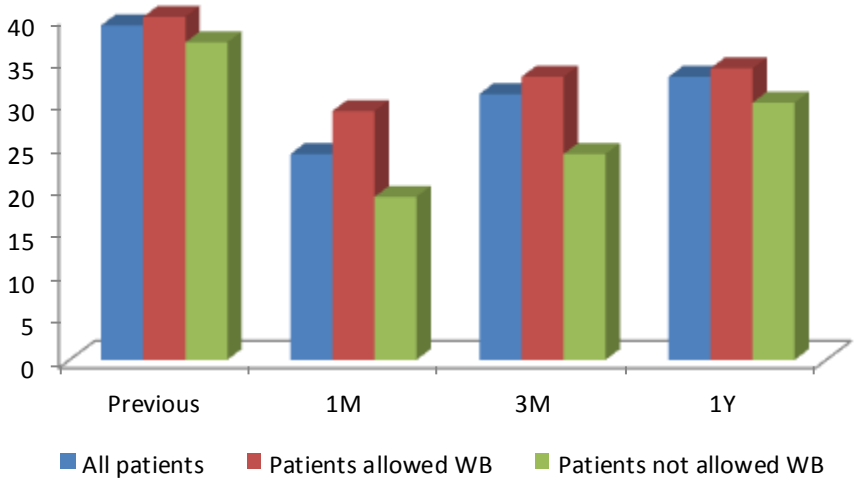

Table 13. Recovery of Self care in percentage according to previous Self care for patients alive at one year

	All patients n=221 Median (Q1,Q3)	Patients allowed WB* n=137 Median (Q1,Q3)	Patients not allowed WB** n=84 Median (Q1,Q3)	p- value
1-Month	71.4 (53.6–85.4)	76.2 (59.5–87.1)	61.9 (45.8–78.9)	<0.001
3-Months	85.7 (64.9–94.7)	88.1 (74.1–95.1)	79.9 (61.1–92.9)	<0.001
1-Year	90.5 (69.9–98.8)	92.9 (76.2–97.6)	85.9 (56.3–100)	<0.001

*, ** Friedman test for WB and NWB groups <0.001

6.3 Change of residence

As regards the residential status, 66% of the whole sample lived in their own home before the fracture, and with 18% of them living alone (Table 14). One year later, this changed to 56% of patients living in their own home (only 7% alone), and more patients were living with relatives or in a nursing home (Table 14). When we consider only patients allowed weight bearing the changes were even bigger with 73% of them living in their own home with 21% living alone before the fracture (Table 15). One year later, 59% of patients lived in their own home (only 8% alone), and more patients changed their place of residence to live with relatives or to a nursing home (Table 15). (Some of these results are included in the first paper: "Change of residence and functional status within three months and one year following hip fracture surgery". Published in *Disability and Rehabilitation* and included as Annex 4).

Table 14 - *Residential Status at Pre-fracture and 1-year After Hip Fracture for all patients.*

	Pre-fracture	1-year, n=221				Pre-fracture
Pre-fracture	status N=275	Own home alone	Own home not alone	Home of relative	Nursing home	status, survivors n=221
Own home, Alone	49 (17.8)	11 (5.0)	12 (5.4)	9 (4.1)	6 (2.7)	38 (17.2)
Own home, not alone	133 (48.4)	4 (1.8)	92 (41.6)	11 (5.0)	4 (1.8)	111 (50.2)
Home of Relative	57 (20.7)	1 (0.5)	4 (1.8)	36 (16.3)	5 (2.3)	46 (20.8)
Nursing Home	36 (13.1)	0 (0)	0 (0)	0 (0)	26 (11.8)	26 (11.8)
Residence at 1-year		16 (7.3)	108 (48.8)	56 (25.3)	41 (18.6)	221

Data are presented as number of patients with (percentage).

Table 15 - Residential Status at Pre-fracture and 1-year After Hip Fracture for patients allowed weight bearing.

	Pre-fracture status N=159	1-year, n=135				Pre-fracture status, survivors n=135
Pre-fracture		Own home alone	Own home not alone	Home of relative	Nursing home	
Own home, Alone	34 (21.4)	8 (5.9)	8 (5.9)	7 (5.2)	5 (3.7)	28 (20.7)
Own home, not alone	82 (51.6)	2 (1.5)	59 (43.7)	7 (5.2)	1 (0.7)	69 (51.1)
Home of Relative	30 (18.9)	1 (0.7)	1 (0.7)	24 (17.8)	2 (1.5)	28 (20.7)
Nursing Home	13 (8.2)	0 (0)	0 (0)	0 (0)	10 (7.4)	10 (7.4)
Residence at 1-year		11 (8.1)	68 (50.4)	38 (28.1)	18 (13.3)	135

Data are presented as number of patients with (percentage).

6.4. Functional outcomes and associated factors

A total of 275 consecutive patients with hip fracture were available for the second study, but 17 had multiple fractures, 18 were readmitted due to surgical complications, 43 died, and 3 withdrew from the study before the one year follow up, leaving 194 patients in the final analysis (Second paper: “Non weight-bearing status compromises the functional level up to 1-year after hip fracture surgery” under review by *American Journal of Physical Medicine & Rehabilitation,* included as annex 4. Results in part were presented at the 13th Orthopedic Congress, EFORT, Berlin, 23-25 of May, 2012. Annex 3).

The patients followed were 158 women (81%) and 36 men with a mean age of 81.4 (6.1); altogether, 119 (61%) were allowed WB at 48 hours after surgery (Table 16). The type of surgery for the 75 patients not allowed WB was: Dynamic Hip Screw with plate (57%), Intra Medullar Hip Screw (29%) and Hemiarthroplasty (14%). Distribution of other baseline characteristics and outcome of the 119 WB and 75 NWB patients is shown in Table 16. As seen, there were no significant differences between patients allowed WB and those who were not for important variables including age, prefracture functional level, cognitive and health status (Table 16). On the contrary, patients who were not allowed WB had more often ($P < 0.04$); an trochanteric fracture, surgery with an intra medullar hip screw or dynamic hip screw with plate, a need for a wheelchair at discharge, fewer rehabilitation sessions during their hospital stay, residence in a nursing home when the fracture occurred, and they were more often discharged to a nursing home from the hospital (Table 16).

Table 16. Characteristics and Outcome Measures of Patients According to Weight-Bearing Status.

Characteristics		Total n = 194	WB n = 119	NWB n = 75	*P*
Age in years		81.4(6.1)	81.2(6.0)	81.6(6.3)	0.7
Sex	Women	158 (81)	94 (60)	64 (40)	0.3
	Men	36 (19)	25 (69)	11 (31)	
Prefracture functional level	Low (FIM 18-90)	48 (25)	25 (52)	23 (48)	0.1
	High (FIM 91-126)	146 (75)	94 (64)	52 (36)	
Body mass index*	≤ 25	72 (38)	49 (68)	23 (32)	0.1
	> 25	120 (62)	69 (58)	51 (42)	
Health status	ASA (1-2)	78 (40)	47 (60)	31 (40)	0.8
	ASA (3-5)	116 (60)	72 (62)	44 (38)	
Cognitive impairment	No/light (Pfeiffer 0-4)	130 (67)	82 (63)	48 (37)	0.5
	Severe (Pfeiffer 5-10)	64 (33)	37 (58)	27 (42)	
Length of hospital stay in days		13.1(9.7)	13.7 (10.8)	12.2 (7.6)	0.3
Type of fracture	Intracapsular fracture	91 (47)	69 (76)	22 (24)	<0.001
	Extracapsular fracture	103 (53)	50 (49)	53 (51)	
Rehabilitation sessions in-hospital number,		4.5 (4.3)	5.0 (5.0)	3.6 (2.7)	0.022
Outpatient rehabilitation within 3-months*	Yes	130 (67)	74 (57)	56 (43)	0.08
	No	63 (33)	44 (70)	19 (30)	
Type of surgery	Dynamic Hip Screw with plate	96 (50)	53 (55)	43 (45)	
	Intra Medullar Hip Screw	33 (17)	11 (33)	22 (67)	<0.001
	Hemiarthroplasty	65 (35)	55 (85)	10 (15)	
Prefracture residence	Own home	128 (66)	84 (66)	44 (34)	0.034
	Relative´s home	42 (22)	26 (62)	16 (38)	
	Nursing home	24 (12)	9 (38)	15 (62)	
Discharge destination	Own home	106 (54)	70 (66)	36 (40)	0.008
	Relative´s home	50 (26)	34 (68)	16 (32)	
	Nursing home	38 (20)	15 (40)	23 (60)	
Assistance at discharge	Formal caregiver	55 (28)	29 (53)	26 (47)	0.1
	Family	139 (72)	90 (65)	49 (35)	
Aid at discharge	Wheelchair	62 (32)	3 (5)	59 (95)	<0.001
	Walker or crutches	132 (68)	116 (88)	16 (12)	
Place of the fall*	Indoor fall	158 (82)	91 (58)	67 (42)	0.034
	Outdoor fall	35 (18)	28 (80)	7 (20)	

Data are number with (percentage) or mean (SD). FIM, Functional Independence Measure; ASA, American Society of Anaesthesiologists rating; SD, standard deviation. *Total number less than 194 due to missing data.

Unadjusted regression analysis showed that WB status in addition to age, prefracture functional level, cognitive health and residential status, significantly influenced the three months and one year functional outcome (P < 0.03), whereas sex, fracture type, and rehabilitation after hospital discharge did not (P >0 .05, Tables 17 and 18).

Table 17. Simple and Multiple Linear Regression Analysis of the 3-month Functional Independence Measure Score (18-126 points) after Hip Fracture Surgery, n=193

Factors	Crude B-values (95%CI)	*P*	Adjusted B-values (95%CI)	*P*
Age (continuous)	-2.2 (-2.8 ─ -1.6)	<0.001	-1.1 (-1.5 ─ -0.6)	<0.001
Men	-8.1 (-19.0 ─ 2.8)	0.1	3.5 (-3.2 ─ 10.2)	0.3
Low prefracture functional level (FIM 18-90)	-41.1 (-52.6 ─ -37.6)	<0.001	-23.8 (-30.8 ─ -16.8)	<0.001
Severe cognitive impairment	-41.0 (-47.9 ─ -34.0)	<0.001	-22.7 (-29.1 ─ -16.4)	<0.001
Rehabilitation session 3 months (yes)	6.8 (-2.3 ─ 15.9)	0.1	2.7 (-3.1 ─ 8.4)	0.1
Within own home pre-fracture (reference)				
Relative´s home pre-fracture	-15.1 (-25.2 ─ -4.9)	0.004	-4.6 (-11.2 ─ 1.9)	0.2
Nursing home pre-fracture	-26.3 (-38.7 ─ -13.9)	<0.001	-7.2 (-16.0 ─ 1.6)	0.1
Low health status (ASA 3-5)	-13.8 (-22.2 ─ -5.3)	0.002	-4.6 (-9.9 ─ 0.6)	0.09
Trochanteric fracture	6.3 (-2.2 ─ 14.8)	0.1	6.5 (1.2 ─ 11.8)	0.02
Non weight-bearing	-16.5 (-25.0 ─ -8.1)	<0.001	-14.1 (-19.6 ─ -8.7)	<0.001

CI, confidence interval; FIM, Functional Independence Measure; ASA, American Society of Anaesthesiologists rating

Multiple linear regression analysis showed that WB status, prefracture functional level, age, and cognitive status (P < 0.001), and fracture type (P =0 .02), to be independent predictors of the 3-month functional outcome, when adjusted for sex, rehabilitation, health and residential status (Table 17). The regression model was statistically stable,

and explained 68% of the variation in the three months functional outcome. Similar results were seen when multiple linear regression analysis was performed for the one year functional outcome (Table 18).

Table 18. Simple and Multiple Linear Regression Analysis of the 1-year Functional Independence Measure Score (18-126 points) after Hip Fracture Surgery, n=193

Factors	Crude B-values (95%CI)	*P*	Adjusted B-values (95%CI)	*P*
Age (continues)	-2.1 (-2.8 ─ -1.5)	<0.001	-1.1 (-1.6 ─ -0.6)	<0.001
Male sex	-7.8 (-19.3 ─ 3.7)	0.2	-3.5 (-11.2 ─ 4.3)	0.4
Low prefracture functional level (FIM 18-90)	-44.7 (-52.9─ -36.5)	<0.001	-24.1 (-32.2─ -15.9)	<0.001
Severe cognitive impairment	-40.5 (-48.1─ -32.9)	<0.001	-22.1 (-29.5─ -14.6)	<0.001
Rehabilitation sessions within 3 months (yes)	6.4 (-3.2 ─ 16.0)	0.2	1.7 (-5.0 ─ 8.4)	0.6
Within own home previous (reference)				
Relative´s home previous	-12.1 (-22.8 ─ -1.3)	0.028	-1.5 (-9.1 ─ 6.1)	0.7
Nursing home previous	-26.2 (-39.3─ -13.1)	<0.001	-6.2 (-16.3 ─ 4.0)	0.2
Low health status (ASA 3-5)	-14.8 (-23.7 ─ -5.9)	0.001	-6.1 (-12.2 ─ -0.1)	0.052
Trochanteric fracture	8.8 (-0.1 ─ 17.7)	0.052	9.3 (3.1 ─ 15.5)	0.004
Non weight-bearing	-16.2 (-25.1 ─ -7.3)	<0.001	-14.6 (-21.0 ─ -8.3)	<0.001

CI, confidence interval; FIM, Functional Independence Measure; ASA, American Society of Anaesthesiologists rating

6.5. Mortality and associated factors

Post-operative mortality within one year of a hip fracture occurred in 21% (95% CI, 16.06-25.94%) of patients. The respective cumulative incidences for mortality at one month were 5% (95% CI, 2.53-8.14%), at three months was 10% (95% CI, 6.59-14.06%) and at six months 16% (95% CI, 11.23-20.09%). (Figures 15 and 16)

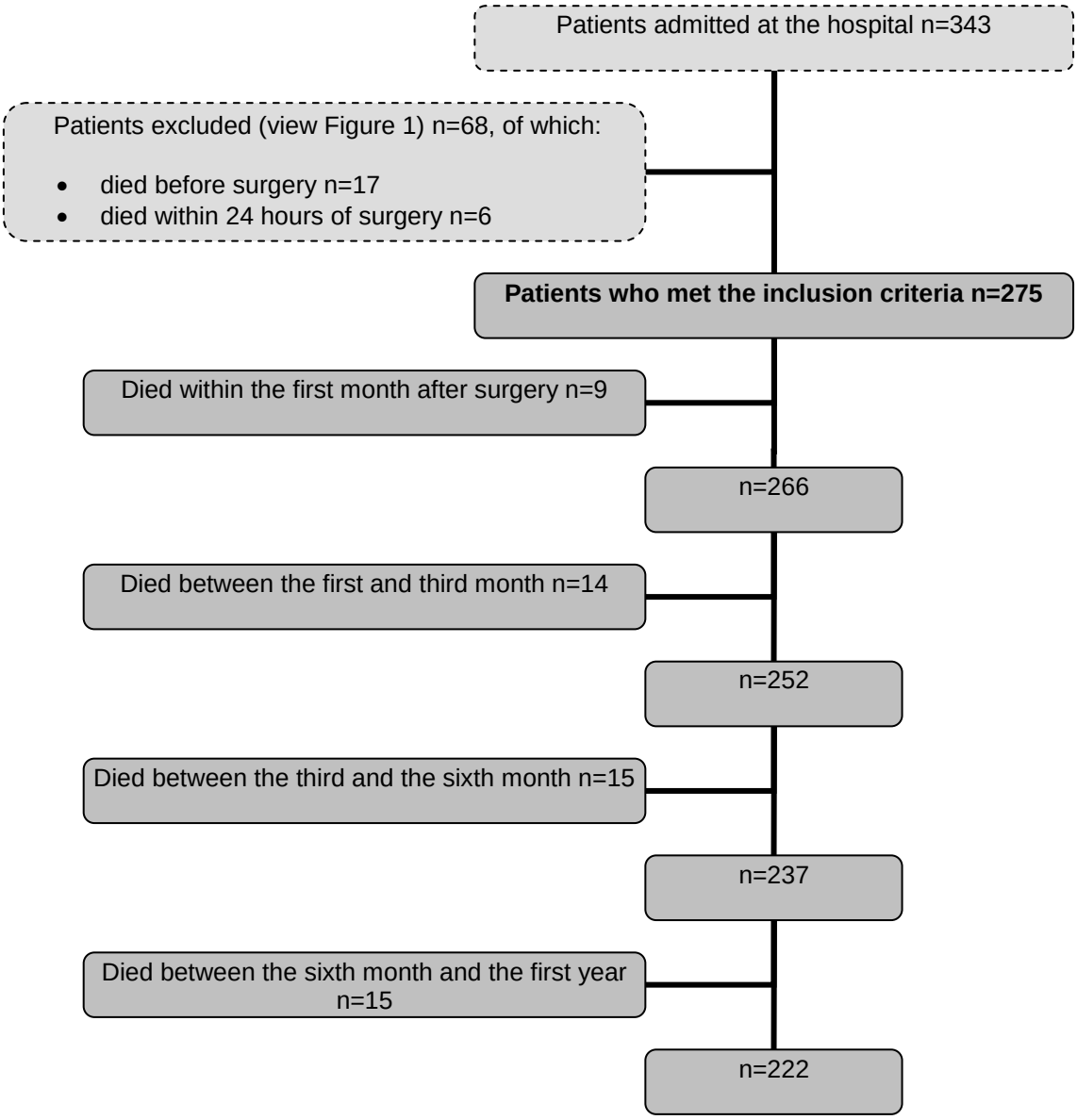

Figure 14. Flow chart of mortality

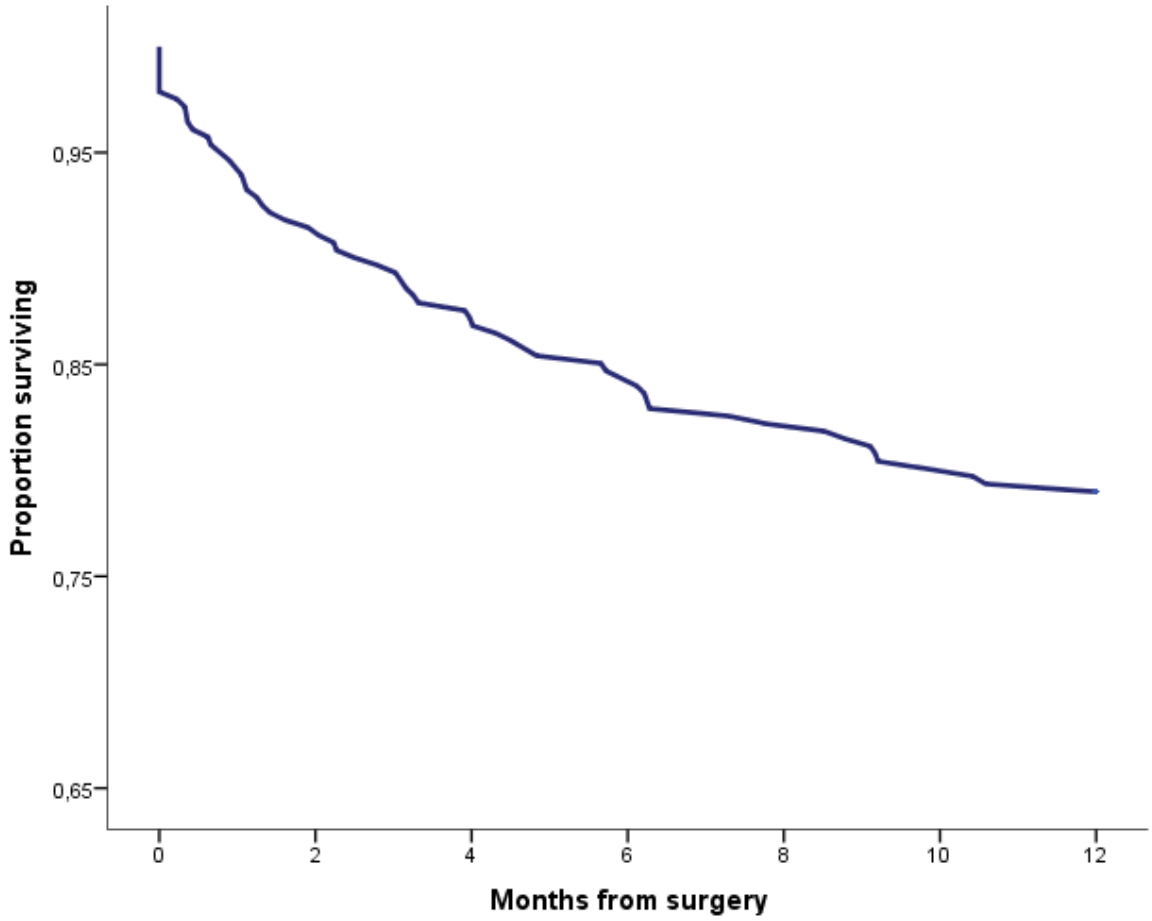

Figure 15. One year Kaplan-Meier estimates of the cumulative probability of survival after hip fracture surgery. (The curve is truncated. Start score Y axis = 0.65).

In the crude analyses, the risk of mortality was higher in men (29% vs 17% women p=0.036), those who had a low prefracture functional level (32 vs 14% p=0.001), had cognitive impairment (33 vs 11% p<0.001) and had a higher Charlson score (median of 7(6-8) vs 6 (5-7) p<0.001). Moreover the unadjusted analysis identifies two modifiable risk factors: Change of residence (33% died, versus 28% continue living in a nursing home versus 16% continue living with relatives or in their own home, p=0.051), and those not allowed weight-bearing after surgery (26% died, versus 14% for those allowed weight-bearing p=0.013). The rest of the variables are shown in Table 19.

Table 19. Table sociodemographic, clinical characteristics and univariate analysis of factors influencing 1-year mortality after hip fracture surgery

Characteristics		Total N=275	Alive n=222	Died n=53	P-value
Age in years		81.4 (6.8)	80.9 (6.4)	83.7 (7.8)	0.15
Sex	Women	216 (79)	180 (83)	36 (17)	0.036
	Men	59 (21)	42 (71)	17 (29)	
Prefracture functional level	Low (FIM 18-90)	74 (27)	50 (68)	24 (32)	0.001
	High (FIM 91-126)	201 (73)	172 (86)	29 (14)	
Body Mass Index n=273*	Normalweight	108 (40)	84 (78)	24 (22)	0.4
	Overweight	111 (40)	89 (80)	22 (20)	
	Obese	54 (20)	47 (87)	7 (13)	
Health Status n=272*	Height (ASA 1-2)	99 (36)	91 (92)	8 (8)	<0.001
	Low (ASA 3-5)	173 (64)	129 (75)	44 (25)	
Charlson Index*		6 (5-7)	6 (5-7)	7 (6-8)	<0.001
Cognitive impairment	No/light (Pfeiffer 0-4)	174 (63)	154 (89)	20 (11)	<0.001
	Severe (Pfeiffer 5-10)	101 (37)	68 (67)	33 (33)	
Time to surgery	Within 24 hours	134 (49)	114 (85)	20 (15)	0.08
	After 24 hours	141 (51)	108 (77)	33 (23)	
Median Length of Hospital Stay (25-75%)		11 (7-18)	11 (7-16)	15 (8.5-21)	0.005
Type of fracture n=272*	Intracapsular fracture	129 (47)	107 (83)	22 (17)	0.4
	Extracapsular fracture	143 (53)	113 (79)	30 (21)	
Weight-bearing	Allowed WB	161 (59)	138 (86)	23 (14)	0.013
	Not allowed WB	114 (41)	84 (74)	30 (26)	
Medical or surgical Complications	No	155 (56)	133 (86)	22 (14)	0.015
	Yes	120 (44)	89 (74)	31 (26)	
Residential status	Relatives or Own home before and after	215 (78.2)	180 (84)	35 (16)	0.051
	Nursery home before and after	36 (13)	26 (72)	10 (28)	
	Change of residence after hip fracture	24 (9)	16 (67)	8 (33)	

Data are number with (percentage) or mean (SD) or median (25%-75% quartiles) *Due to missing data.

A Kaplan-Meier survival chart for residence status is shown in Figure 16. During the one year follow-up period, the probability of surviving a hip fracture was significantly lower for those who changed their place of residence (84% living at their own home or with relatives (blue), 72% living in a nursing home (green), 67% changing the place of residence (red) (p= 0.029), Figure 16.

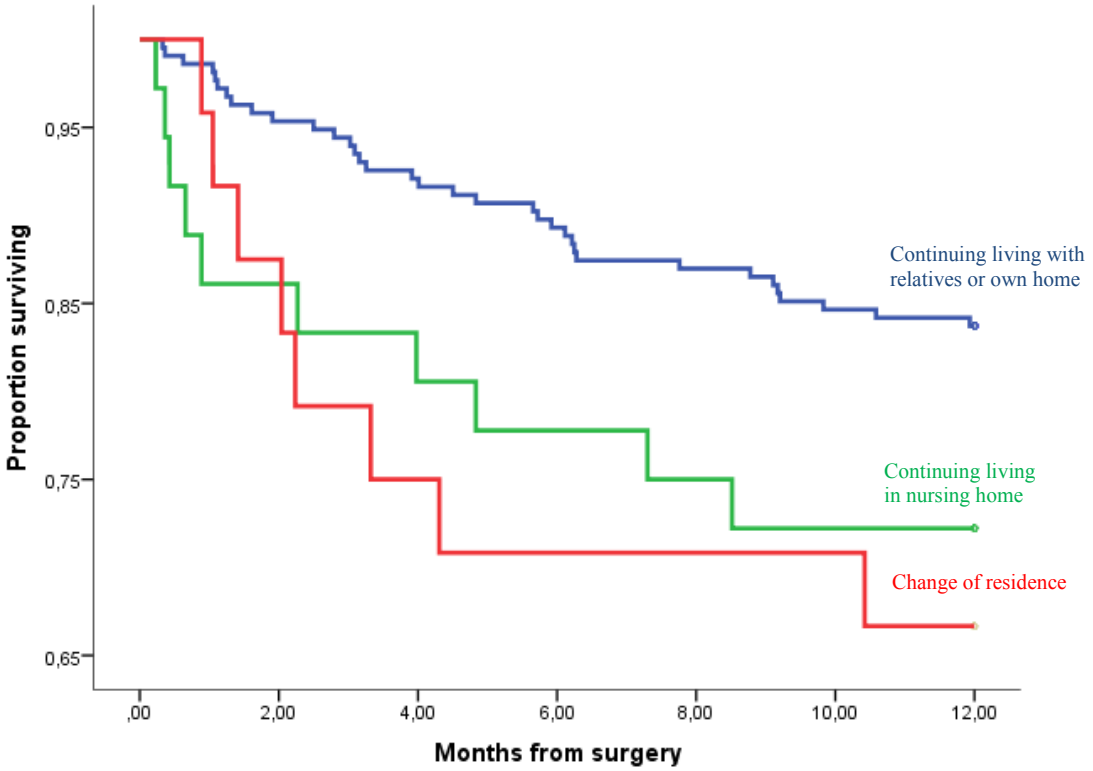

Figure 16: Residential status and survival within 1-year of hip fracture surgery

In the adjusted analysis, the rate of mortality was 2.86 times higher in men compared with women, 2.78 times higher in those who changed their place of residence compared with those who continued living with relatives or own home, 2.20 times higher in those with cognitive impairment compared with no cognitive impairment, 1.76 times higher in those not allowed WB after surgery compared with those allowed WB (almost significant, p=0.07), and 1.24 times higher per point in the Charlson index score (Table 20).

Table 20. Risk factors of mortality in the period of one year after surgery. Cox regression Model.

Risk Factors	Unadjusted HR (95% CI)	P-Value	Adjusted HR (95% CI)	P-Value
Age (per year of increase)	1.07 (1.02 - 1.12)	0.003	1.03 (0.98 - 1.08)	0.2
Sex				
Women	Reference		Reference	
Men	1.83 (1.03 - 3.25)	0.041	2.86 (1.55 - 5.31)	0.001
Cognitive status				
No cognitive impairment	Reference		Reference	
Cognitive impairment	3.25 (1.86 - 5.66)	<0.001	2.2 (1.14 - 4.26)	0.019
Prefracture functional level				
High prefracture functional level	Reference		Reference	
Low prefracture functional level	2.43 (1.42 - 4.18)	0.001	1.36 (0.7 - 2.63)	0.4
Charlson index(per score of increase)	1.25 (1.12 - 1.4)	<0.001	1.24 (1.08 - 1.41)	0.002
Type of fracture				
Intracapsular fracture	Reference		Reference	
Extracapsular fracture	1.25 (0.72 - 2.17)	0.4	1.23 (0.68 - 2.23)	0.5
Weightbearing status				
Allowed Weightbearing	Reference		Reference	
Not Allowed Weightbearing	1.99 (1.16 - 3.43)	0.013	1.76 (0.96 - 3.22)	0.07
Residence status at discharge				
Continue living with relatives or own home	Reference		Reference	
Continue living in a nursing home	1.92 (0.95 - 3.88)	0.07	0.86 (0.4 - 1.83)	0.7
Change of the residence´s place	2.27 (1.05 - 4.88)	0.037	2.78 (1.25 - 6.19)	0.012

Note: HR= Hazard Ratio; CI= Confidence Interval

(The data of mortality and associated factors are part of the third paper: “Predictors of long term mortality in elderly patients with hip fracture” under review by *Journal of Gerontology* and included in this document as annex 4)

6.6.Compliance of the guidelines for hip fracture patients

The following data try to show if the recommendations of the guidelines were followed at the service where the study was carried out.

1. *Assessment protocol in the emergency department and fast admission to the orthopedic service within the first four hours after the fracture.*

The time to admission usually is longer but we do not have exact data for this variable.

2. *Comprehensive patient assessment; including comorbidity, medication, functional status, cognitive status and social status.*

This recommendation was not followed. Information included in the medical score was mainly related with comorbidity and medication. There are no records of functional and cognitive status. The social status is not well tabulated either.

3. *Intravenous fluid therapy if risk of dehydration and hypovolemia*

The patients received this treatment.

4. *Preventive strategies:*

    a. *Prophylaxis of venous thromboembolism.*

All the patients were treated with low molecular weight heparins

    b. *Prevention of pressure ulcers.*

All patients have special air mattresses, frequent assessment of skin condition and prevention of risk factor.

c. *Delirium*

Patients were medicated when they showed delirium, but not preventive medication. They received the rest of the treatment to try to control the main vital signs and the balance of fluid levels.

d. *Constipation*

The patients had a special diet and they had osmotic laxatives when it was necessary. They received treatment when they had constipation but not all the patients received preventive actions such as early mobilization or fiber intake.

e. *Oxygen supplementation to prevent heart problems: mainly during the first six to seventy two hours after surgery.*

Patients usually did not receive this treatment unless they had breathing problems before the surgery.

5. *Time to surgery: within the first 24 hours (NZGC 2003 and SIGN 2009), within 14 to 36 hours (SEGG-SECOT 2007) and within 48 hours (BOA-BGS 2007)*

Only 64 patients (33%) had surgery within the first 24 hours from the admission with the fracture.

6. *Early mobilization: sitting and WBAT from 24 hours after surgery but with some exceptions depending on the patients and the result of the surgery.*

Only 119 patients (61%) were allowed weight bearing as tolerated within 48 hours after surgery and 33% of the patients did not receive outpatient rehabilitation within three months after surgery.

7. *Treatment of common clinical problems:*

    a. *Anaemia: the blood transfusion is not recommended if the hemoglobin level are >10g/dl*

We do not have data of this variable

    b. *Pain: the individual evaluation is very important. All the guidelines recommend the prescription of paracetamol and if it is necessary the use of some minor opiates and even the use of morphine in special cases to avoid the pain.*

The patients usually have paracetamol and some minor opiates if pain persists.

    c. *Malnutrition: the common use of nutritional supplements is recommended for all the guides.*

A nutritionist designs the diet of each patient.

8. *Coordinated treatment between orthopedic surgeons and geriatricians.*

There were no geriatricians at the service. The surgeon consults the medical service (internist) of the hospital when the patients have some medical complications.

7.

Discussion

7.1. Discussion of the methodology

7.1.1. Study design

We carried out a prospective cohort study instead of a case-control study because we wanted to determine the factors related to the functional outcome and mortality after a hip fracture. Moreover, the hip fracture is a frequent event in the elderly population (Abrahamsen et al. 2009, Brauer et al. 2009, Alarcon et al. 2010, Dhanwal et al. 2011), and a cohort study should provide an adequate sample size.

The follow-up period was one year because we were looking at long term functional outcomes and mortality. We chose one year because during this period of time the patients should have received all the care necessary in order to recover their previous functional level. Furthermore, in the literature there are more studies with short follow up times (Candel-Parra et al. 2008, Tarazona-Santabalbina et al. 2012), or looking at the short term mortality (Bergeron et al. 2009, Frost et al. 2011, Librero et al. 2012), than the number of studies that look at long term mortality.

7.1.2. Representativeness of the study population

All patients who had a hip fracture and met the inclusion criteria were invited to participate in the study and only three patients refused to take part in the study or were missing.

Some data such as the age, sex, residence status or percentage of obese people are in accordance with that reported for the Spanish elderly population (Abellan-Garcia et

al. 2012 Available in: http://www.imsersodependencia.csic.es/documentos/ documentos/pm-indicadoresbasicos12.pdf.)

Our study is similar to other reports that studied patients with hip fracture regarding variables such as age, sex, comorbidities, cognitive or health status (Rosell et al. 2003, Haentjenset al. 2005, Adunsky et al.2008, Castronuovo et al 2011, Pioli et al. 2011). The profile of a typical hip fracture patient is a woman (Rosell et al. 2003, Adunsky et al.2008, Castronuovo et al 2011, Pioli et al. 2011) with a mean age around 80 years (Rosell et al. 2003, Adunsky et al.2008, Bergeron et al. 2009, Castronuovo et al 2011,) and several comorbidities (Haentjenset al. 2005, Adunsky et al. 2008, Bergeron et al. 2009, Pioli et al. 2011), that lives in their own home prior to the fracture (Haentjenset al. 2005, Bertram et al. 2011). Moreover, a high percentage of the patients included in the reports showed cognitive impairment (Adunsky et al.2008, Pioli et al. 2011) and high surgery risk (Alarcon et al. 2011), as did the patients in our study.

7.1.3. Quality of information

The information was collected prospectively within one year and the interviews were done face to face until the third month. The last interview (one year after surgery) was done by phone. One interviewer was trained to carry out all the interviews.

7.1.4. Limitations and strengths

The limitations of our study include:

- The one-year follow-up interview was performed by phone and was on occasion reliant on information supplied by relatives, which may have influenced the results. A similar approach has been used in a previous study (Heikkinen et al. 2005).

- Although the hospital protocol establishes that all patients should receive a similar amount of rehabilitation sessions, the reality is far different, mainly due to hospital bureaucracy. Also, there are considerations that may interfere with patients´ receiving rehabilitation after hospital discharge, e.g. their residential status and decisions made by surgeons. In fact, only a few in-hospital sessions were given to the patients included in our cohort, while 70% of WB patients and 30% of NWB patients received no sessions at all after their hospital discharge. Furthermore, the type of rehabilitation and the time period of duration were not standardized. However, assessing the amount of rehabilitation, or the rehabilitation techniques used was not the purpose of this study, and is also not reported in other follow-up studies (Rosell et al. 2003, Heikkinen et al. 2005, Alarcon et al. 2011). We strongly recommend that such knowledge be included in future studies.

- Patients who did not have surgery due to medical decision and those who died before surgery were not included in the study. Data from patients who died 24 hours after surgery were also not recorded, as the relatives were not available to sign the informed consent, so the patients were only included to calculate the total mortality.

The methodological strengths of our study include:

- Its prospective design with consecutively admitted patients
- The long-term follow-up period with consecutive inclusion of patients, regardless of their sex, cognitive, health or residential status.
- The use of the FIM, a well-validated instrument to measure functional outcome.
- To our knowledge, this is the first study evaluating the long-term influence of WB status in terms of the functional outcome of patients having surgery after a cervical or trochanteric hip fracture.
- To our knowledge, there are no studies about long-term mortality and factors associated in this part of the country.
- We had a very low rate of missing data, which reduces information bias.
- The rate of rejection was very low, so our sample is considered very representative of the population of the region.

7.2. Discussion of the results

This study of changes in functional status following hip fracture and long term mortality provides evidence that: 1) Functional recovery was not achieved in all the ADL items within one year of fracture for most of the patient's studied. 2) There were differences in the time required to regain functionality in the activities evaluated. 3) An important number of patients had to change their residential status within one year following the hip fracture. 4) Patients who had two to four weeks of NWB status following surgery had a significant decrease in their functional level at one year after surgery when

compared with patients allowed WB. 5) The one year mortality for patients who died from 24 hours after surgery to one year thereafter was 21%, and the main associated factors were men sex, cognitive impairment, high Charlson index score, NWB status and change of residence.

7.2.1. Functional recovery

Total FIM scores suggest that loss of function should be considered a minor problem for patients alive one year after a hip fracture, if we compare with other countries. That is, the median loss of function for survivors was only 9% (10% if we include patients not allowed WB) in the present study, as compared to a mean loss of function of 21% in a British study (Rosell et al. 2003), and especially when compared to a Portuguese study reporting that more than 75% of patients became totally dependent after hip fracture (Da Costa et al. 2009). A previous study of patients with hip fracture in a Spanish population reported a mean functional loss of 19% six months afterwards, yet it only included patients who had no cognitive impairment and were independent in ADL before the fracture (Candel-Parra et al. 2008). These differences might be related to the different follow-up periods or the use of a different scale to measure the functional level (the FIM instead of the Barthel used by Candel Parra el al.).

Still, findings from the present study underline the importance of not just relying on results gained from total ADL scores. The loss of function was higher in certain categories of the FIM, and especially in important activities related to independence, or to recovery of the pre-fracture level of independence. That is, transfer from bathtub/shower, dressing lower body and walking up/down stairs were only regained, respectively, by 54%, 58% and 64% of patients; and rates of independence at one year for these items were as low as 30%, 42% and 43%, respectively. These findings are in line with those of a similar study carried out in Spain by Alarcon et al., looking into

recovery for activities such as transfer (60%) and climbing stairs and bathing (68%) at one year (Alarcon et al. 2011). In contrast, a Finnish study reported as many as 68% of patients were independent in bathing/showering, and 79% at dressing, one year following fracture (Heikkinen et al. 2005). Interestingly, these Finnish patients stayed only 7.7 days on the average in the acute hospital setting (Heikkinen et al. 2005), as compared to a mean of 13.5 days in the present study and other Spanish studies (Da Candel-Parra et al. 2008, Alarcon et al. 2011). Our patients were discharged to their own home, to relatives or a nursing home, and continued rehabilitation if at all having any, in outpatient services, in contrast to some countries of northern Europe where patients are usually discharged to inpatient rehabilitation facilities (85% of the patients in the Finnish study). Similarly, in a US study, the mean hospital stay was 7.2 days in hospital, and just 14% were sent home directly after hip fracture (Bentler et al. 2009), while in a Danish study, 76% of patients admitted from their own home were discharged directly to their own home again, after a median of 11 (8-15) days in the acute hospital (Kristensen et al. 2012).

Clearly, from one country to another there is a variety of health care systems and rehabilitation courses following hip fracture, which most likely influences the final outcome. Accordingly, comparison of the rehabilitation provided after discharge from different hospitals reveals great variation, from none at all to more than 21 sessions. In Spain there is a wide variation in terms of the rehabilitation sessions that patients receive, because there are no inpatient rehabilitation facilities where these kinds of patients can be discharged to from the acute hospital, and the outpatient rehabilitation services are different from some villages to others. More efforts should be carried out to provide rehabilitation sessions for all the patients at discharge independently of the place where they live.

Time to recovery

It was hoped that our results would help us identify the "most adequate" time period to follow patients with hip fracture for the evaluation of their functional recovery. Previous studies indicate that most recovery happens within the first four (Heikkinen et al. 2005) to six months (Alarcon et al. 2011), although specific items require recovery over the entire first year (Heikkinen et al. 2005, Alarcon et al. 2011). The study of Heikkinen et al. had some important differences to our study, in that it included patients of 50 years and older, they considered different functional activities to the activities included in the FIM, and most of their patients were discharged to rehabilitation units. The activities that improved after four months were dressing, eating, cooking and walking, while the activities of bathing, shopping, doing laundry and managing toileting, household chores and money matters managing remained unchanged (Heikkinen et al. 2005). The report conducted by Alarcon et al. showed a recovery of the activities such as ambulation, use of the toilet, transfers, feeding and grooming primarily during the first 6 months, though the main recovery of these activities was within the first 3 months (Alarcon et al. 2011). Another study proposes that the overall trend of recovery in ADL function is seen at two months of post-acute rehabilitation, and continued within six months, after which functional recovery appears to be minimal yet constant throughout the remainder of the first year (Young et al. 2010).

Along these lines, we found no recovery beyond three months for activities such as dressing, bladder and bowel management, grooming and eating; yet walking up/down stairs, bathtub/shower transfer and bathing continued to improve from three months to one year (though the pre-fracture level was not reached). It is interesting to mention too that time to recovery was different for patients allowed WB and those not allowed WB. The main recovery for activities such as self care or mobility was within the first three months for patients allowed WB and within the entire first year for patients not allowed WB.

7.2.2. Change of residence

Residential status in southern Spain is somewhat different than in northern European countries, probably because of a different family structure, and/or cultural influences. Thus, 21% of our patients resided at the home of a relative and only 13% in a nursing home at pre-fracture, as compared to 31% living in residential or nursing homes in England at pre-fracture (Rosell et al. 2003). None of the 49 (18%) patients in the present study living alone in their own home at pre-fracture were discharged to their home directly from the hospital, and only 7% went back to living alone after one year. Many patients lived in the home of a relative (25%), in contrast to other countries (Rosell et al. 2003, Heikkinen et al. 2005) where more live in a nursing home and none at the home of a relative, which again reflects different cultural, social and health care systems. Nonetheless, internationally, changes to residential status after a hip fracture are somewhat similar in the sense that more people reside in "care" facilities.

Most patients in our study were elderly women, who lived in their own home, with characteristics similar to those of patients included in other studies (Rosell et al. 2003, Young et al. 2010, Hershkovitz et al. 2012). The change of residence and failure to regain the pre-fracture functional level found in this and other studies (Rosell et al. 2003, Heikkinen et al. 2005, Da Costa et al. 2009, Alarcon et al. 2011) would suggest that what is considered good treatment for patients with hip fracture is, in fact, insufficient. It may be that more sessions of rehabilitation are needed, with physical and occupational therapy in the post-operative period and the months following discharge, and an evaluation of possible adaptive measures for the place of residence. This is supported by a recent literature review on the rehabilitation after hip fracture that found extended exercise programs to improve the function of patients with hip fracture (Auais et al. 2012). A study carried out by Hershkovitz et al. showed that 55.4% of hip-fracture patients were unable to maintain their rehabilitation achievements in terms of functional

status one year after discharge from the rehabilitation unit (Hershkovitz et al. 2012). In addition, the cooperation between therapists, geriatricians and orthopaedic surgeons appears to be worth recommending, as results are found to be better in patients who follow joint programmes (Stenvall et al. 2007, Munin et al. 2010, Arinzon et al. 2010, Di Monaco et al. 2011). Compliance with the recommendations of clinical practice guidelines should be higher to try to reduce the variability of the results between different services and countries.

7.2.3. Associated factors with functional outcomes

We found that 39% of patients had two to four weeks of NWB status following surgery, and this was associated with a significant decrease in their functional level at 1 year after surgery. Thus, an average NWB patient with low prefracture function (FIM < 91 points) and cognitive impairment (Pfeiffer score 5-10) had FIM total scores that were respectively 15, 24, and 22 points lower at 1-year than those of patients allowed WB, with high prefracture function, and no cognitive impairment. In addition, a patient with a trochanteric fracture had, on average, a score 9 points higher than one with a cervical fracture, while FIM total scores decreased 11 points per decade of age when adjusted for sex, rehabilitation after discharge (yes or no), residential and health status. Below we discuss each of the variables considered

Baseline characteristics

Our study, in line with many previous ones, established age (Haentjens et al. 2005, , Penrod et al. 2008, Wu et al. 2009, Kristensen et al. 2010, , Kristensen 2011, Dubljanin-Raspapovic et al. 2012, Pioli et al. 2012, Tarazona-Santabalbina et al. 2012, Yung et al. 2010.), cognitive status (Penrod et al. 2008, English et al. 2010, Kristensen 2011, Pioli et al. 2012, Tarazona-Santabalbina et al. 2012), and prefracture functional level (Kristensen 2011, Dubljanin-Raspopovic et al. 2012, Fukui et al. 2012, Tarazon-

Santabalbina et al. 2012) as independent factors influencing the long-term functional outcome of patients with hip fracture. This strengthens the validity of NWB status as an independent factor influencing a patient´s long-term functional outcome, when analyzed together with these previously established strong predictors, as also used in the present study.

Fracture Type

Patients with a trochanteric fracture had mean FIM scores that were seven points higher at 3-months and nine points higher at 1-year than the scores of patients with cervical fractures in this study. In contrast, Haentjens et al. (2007) found that the functional outcome among women was better for those with a cervical fracture as opposed to those with an intertrochanteric fracture upon hospital discharge, but with no fracture-type differences one year later (Haentjens et al 2007). A study by Adunsky et al. (2001) did not detect any association between functional recovery and type of fracture in women without cognitive impairment during the rehabilitation period. Most reports (Adunsky et al. 2001, Di Monaco et al. 2007, Kristensen et al. 2010) look at the fracture-type influence on short-term outcome, for which reason the long-term outcome, addressed by the present study, is still a matter of great uncertainty.

Length of stay

Patients with a NWB status stayed fewer days in the acute section of the study hospital as compared to patients allowed WB. In a previous study, patients with restricted WB stayed longer in hospital for rehabilitation than those with WBAT (Wu et al. 2009). This apparent discrepancy may depend upon the discharge criteria of different settings and health care systems. In some countries, patients are mainly discharged to and cared for by their relatives, not by the health care system, and are discharged when they are medically stable. Thus, our NWB patients were discharged sooner than patients

allowed WB, and hence started rehabilitation in an outpatient rehabilitation facility (if at all) when they were ready to bear weight on the fractured limb.

Weight-Bearing

We found no significant difference between WB and NWB patients in variables such as age, gender, health status, cognitive status, and prefracture functional level. Similar findings are reported by Wu et al. (2009) and Siebens et al. (2012).

Still, an average NWB patient was found to have a FIM total score that was respectively 14 and 15 points lower at 3-months and 1-year post-surgery as compared to one with no restrictions. Interestingly however, a higher proportion of NWB patients, as opposed to WB patients, had undergone outpatient rehabilitation sessions within three months after surgery. Nonetheless, the two to four weeks of immobilization (95% of wheelchair-bound patients discharged from hospital were NWB) might explain the long-term loss of function in the NWB patients of the present study. Indeed, injury and even a short period of immobilization accelerate the loss of lean muscle mass in elderly people, and a high percentage probably showed signs of sarcopenia (age-related loss of lean tissue mass) implying a loss of strength and function already before having the hip fracture (English et al. 2010).

Siebens et al. found no difference in the functional outcomes assessed with the FIM in their 8-month follow-up study (Siebens et al. 2012), and Wu et al. found no difference in mobility status upon discharge and return to pre-fracture living status (Wu et al. 2009) when comparing patients allowed WBAT and those with restricted WB. Yet comparison between these two studies and the present contribution is not possible, as the study by Siebens et al. included “only” selected patients with arthroplasty and had a low follow-up rate (84 out of 224 patients), while patients with restricted WB in the study by Wu et al. stayed significantly more days in hospital for rehabilitation.

Moreover, both studies used a definition of WB that included only 2% (Siebens et al. 2012) and 8% (Wu et al. 2009) of patients with a NWB status out of respectively 21% and 23% with restricted WB. That is, their “restricted” patients were actually allowed some level of WB.

The proportion of NWB patients in the present study is much higher than that of studies published within the last three years (Wu et al. 2009, Siebens et al. 2012) (less than 24% with WB restrictions), and much higher than reports from Northern Europe (2% with WB restrictions) (Kristensen et al. 2012). The latter reflects recommendations of unrestricted WB after hip fracture surgery, e.g. Koval et al. (1998), over 15 years ago. We should also stress that the present study included patients with cognitive impairment and those not living in their own homes, unlike the study by Koval et al. At any rate, this does not justify the large proportion of NWB patients in our context. Evaluation of the criteria underlying the recommendation of NWB at the study hospital is clearly needed, especially since patients allowed WBAT apparently limit loading of the fractured limb within the months following hip fracture surgery (Koval et al. 1998, Nightingale et al. 2010).

Although surgical complications (osteosynthesis failure or arthroplasty dislocation) were encountered after hip fracture surgery in the present sample, there was no difference in relation to WB status: 10 out of 129 (8%) WB as compared to 8 out of 83 (10%) NWB were re-admitted due to some kind of surgical complication. Further research into surgical procedures and associated failures after hip fracture surgery, as put forth in a 2012 study (Palm et al. 2012), is needed.

Orthopaedic surgeons ought to evaluate whether more patients could be allowed WB immediately after surgery, while clinicians focusing on the other variables of influence

could identify patients more likely not to return to their prefracture functional level, or achieve substantial recovery, in order to improve the rehabilitation provided.

7.2.4. Mortality and associated factors

Our third study (Annex 4) showed that the mortality one year after surgery was 21% of the patients. The risk of mortality was higher during the first six months (16%) and then declined thereafter. This is consistent with other reports and reviews that showed a mortality range of 22-30% at one year (Haleem et al. 2008, Castronuovo et al. 2011, Pioli et al. 2011,Tarazona-Santabalbina et al. 2012).

Our results show that age, men sex, cognitive impairment, low prefracture functional level, higher Charlson score, not allowed weight-bearing after surgery and change of residence are significant predictors of mortality at one year in unadjusted analysis. These data confirm part of the main results of other reports (Johansen et al. 2010, Castronuovo et al. 2011, Pioli et al. 2011, Vocheloo et al. 2011, Gonzalez-Rozas et al. 2012). However, these studies did not consider the variables of change of residence and NWB status as independent predictors of mortality at one year. The influence of the different variables is discussed in the following.

Weight-bearing Status

The risk of not surviving one year from surgery was two times higher for a NWB patient when we compared with one allowed WB in unadjusted analysis and almost significant in the adjusted. The influence of early weight bearing and mobilization on the postoperative functional outcome after a hip fracture has been evaluated in a number of studies (Wu et al. 2009, Siebens et al. 2012). However there is a lack of knowledge of the influence of the weight bearing on the mortality after hip fracture.

Change of residence

The change of residence after a hip fracture (from own or relatives home to a nursing home) is a risk factor of mortality in our population. Thus, the risk of not surviving one year from surgery was three times higher for a patient who changed the place of residence when we compared with one that continues living in their own home or the home of a relative. These results are consistent with the results of a British study (Johansen et al. 2010) which showed that patients who were able to return to their own homes had a median survival of 5.25 years while those who had to change residence to institutional care had a median survival of 1.33 years. An Australian report (Harris et al. 2010) showed that the overall hazard ratio for death in nursing home patients one year after hip fracture was 1.8 (95% confidence interval of 1.4-2.4). However, the change of residence should be studied more in depth because most of the reports studied the prefracture residence as a risk factor but they do not include the change of residence in adjusted analyses. The residential status and the social support differ between countries. In Spain, patients who changed their place of residence were typically those who had a low health status (most of them were looked after by their relatives before the fracture) and the hip fracture adversely affected their poor health status (they went to live in a nursing home after the hip fracture). Nevertheless some other factors must influence the mortality because in the adjusted analyses the poor health status was included and the change of residence continued to be a significant risk factor of mortality.

Fracture Type

The type of fracture was not associated with mortality at one year in our study. This is consistent with a review carried out by Kristensen et al. (2011) and with a study by Sund et al. (2009) that found no differences in the one year mortality after hip fracture between intracapsular and extracapsular hip fractures.

However, a report carried out by Haentjens et al. (2007) showed that the risk of death at one year from surgery was more than double for women with intertrochanteric fractures than for those with femoral neck fracture (cervical). This difference might be explained by the fact that this study only included women, 50 years or older (Haentjens et al. 2007).

Other variables

The adjusted analysis showed men sex, cognitive impairment and higher Charlson index as significant predictors of mortality at one year. These results are consistent with other studies that also found men sex (Hommel et al. 2008, Bentler et al. 2009, Johansen et al. 2010, Castronuovo et al. 2011, Gonzalez-Rozas et al. 2012,Tarazona-Santabalbina et al. 2012), cognitive impairment (Hommel et al. 2008, Gonzalez-Rozas et al. 2012,Tarazona-Santabalbina et al. 2012), a higher Charlson Index or the presence of comorbid conditions (Bergeron et al. 2009, Castronuovo et al. 2011, Pioli et al. 2011) as significant predictors of long term mortality.

The main difference of our results to the results in the previous literature is related with age. Age was found to be a predictor of mortality in several studies (Lefaivre et al. 2009, Johansen et al. 2010, Castronuovo et al. 2011, Vochteloo et al. 2011, Gonzalez-Rozaas et al. 2012). However, in our study the age was a predictor only in the unadjusted analyses, but not when the data was adjusted by the rest of the variables. Still, this is consistent with the results of a study (Holvik et al. 2010) carried out in an orthogeriatric unit in Norway, where the age was not a predictor of mortality when it was adjusted by gender, prefracture residence, type of fracture, time to surgery, number of comorbidities, health status, complications after surgery, and type of complications (Holvik et al. 2010). An Australian report (Hindmarsh et al. 2009) found that the age effects over the risk of death were significant only during the first three

months after surgery. This result suggests that the mortality due to a hip fracture could be explained by other factors more important than age, and that we should make more effort to clarify those factors.

The high risk of death after a hip fracture for men, those with cognitive impairment, and those with some associated illness has all been reported in previous studies. (Hommel et al. 2008, Bentler et al. 2009, Bergeron et al. 2009,Johansen et al. 2010, Castronuovo et al. 2011, Pioli et al. 2011, Gonzalez-Rozas et al. 2012,Tarazona-Santabalbina et al. 2012). More effort should be made to prevent the hip fractures, and to investigate modifications in the postoperative care in this population in order to reduce the high likelihood of mortality. On the other hand, the absence of knowledge about the exact impact of each factor and the conflicting views in the literature about some of these factors show the need for further detailed studies.

7.2.5. Compliance of the guidelines

When we compare the recommendations of the clinical practice guidelines with the results of our study, we found that some important points such as; 1) comprehensive patient assessment, 2) surgery within 24-48 hours, 3) early mobilization with weight bearing as tolerate from 24 hours after surgery, or 4) coordinated treatment between orthopaedic surgeons and geriatricians, were not carried out in the study hospital.

The compliance of the guidelines is difficult to confirm with the results published in the literature. The studies usually refer to parts of the care of the patients with hip fracture, and we can find several studies without information related for example with time from admission to surgery (Alarcon et al. 2011, Haentjens et al. 2007), early and kind of rehabilitation (Haentjens et al. 2007, Alarcon et al. 2011,Rodriguez-Fernandez et al.

2011), and coordination between orthopaedic surgeons and geriatricians (Haentjens et al. 2007)

However, there are some services which tried to follow the guidelines and even propose new strategies of treatment with special emphasis in the comprehensive geriatric assessments, early surgery and rehabilitation, active prevention and treatment of postoperative complications, and coordinated team work between surgeons, geriatricians, nurses, physiotherapist, occupational therapist and social workers. (Stenvall et al. 2007, Neuman et al. 2009, Adunsky et al. 2011, Giusti et al. 2011).

8.

Conclusions

1. Un año después de la intervención quirúrgica por la fractura de cadera, la mayoría de los pacientes no había recuperado su nivel de funcionalidad previo. Las actividades que se vieron más afectadas al año de seguimiento fueron: el vestido de la parte inferior, el baño, las transferencias y el subir y bajar escaleras. Los programas de rehabilitación deberían incluir el entrenamiento para la recuperación de las actividades de la vida diaria y no solamente la movilidad.

   La mayor parte de la recuperación funcional tras la fractura de cadera tuvo lugar durante los primeros tres meses, que es el periodo de tiempo en el cual los pacientes recibieron rehabilitación (aquellos que la tuvieron). En los meses posteriores, la recuperación funcional fue continua pero reducida. La rehabilitación fue insuficiente. Sería interesante plantear futuros estudios para evaluar si una rehabilitación más extensa podría mejorar los resultados funcionales a largo plazo.

2. Al año de la fractura de cadera, un número importante de pacientes tuvieron que cambiar su lugar de residencia, suponiendo un incremento de la carga de cuidados para sus familiares, lo cual es bastante común en el sur de España. Sería necesario mejorar la coordinación con los servicios sociales, y que los pacientes tuvieran la oportunidad de tener más cuidados en su domicilio y mejor acceso a la rehabilitación.

3. Son factores predictores de la recuperación funcional a los tres meses y al año de la intervención quirúrgica de la fractura de cadera: el apoyo precoz del miembro operado tras la fractura de cadera, el nivel funcional previo, el estado

cognitivo, la edad y el tipo de fractura. El apoyo precoz, como único factor de riesgo modificable de los mencionados anteriormente, debería ser prescrito por los cirujanos y procurado por todo el equipo que trata a estos pacientes.

4. La mortalidad en ancianos al año de la intervención por fractura de cadera es del 21% en el sur de España. El hecho de ser hombre, tener deterioro cognitivo, un mayor número de comorbilidades, el apoyo tardío sobre el miembro intervenido y el cambio de residencia fueron asociados con la mortalidad a largo plazo. Sería necesario incrementar la vigilancia de este perfil de paciente.

1. Most patients did not fully recover their previous functional level one year after hip fracture surgery and the activities most affected at the one-year follow-up were: dressing lower body, bathing/showering, transfer bathtub/shower and walking up/down stairs. Rehabilitation programs should not be based only on mobility activities, the recovery of other daily living activities should also be included

   After a hip fracture, the major part of recovery took place during the first three months after surgery, which is the time period when patients would undergo rehabilitation (if having any at all), while a continual but reduced recovery was seen over the subsequent months. The rehabilitation provided was somehow insufficient. Further studies should evaluate if extended rehabilitation could improve the long-term outcome.

2. A significant number of patients had to change their residential status within one year following the hip fracture, entailing a greater burden of care for the relatives, which is a common practice in the context of southern Spain. It is necessary to have better coordination with the social services, and the patients should have the opportunity to have the main portion of care and rehabilitation at their home.

3. The WB status of an elderly patient after surgery for hip fracture, in addition to prefracture function, cognitive status, age and fracture type, can be considered as independent predictors of both their three months and one year functional outcome. The practice of early WB (recommended by the clinical guidelines)

should be fostered at the hospital by the surgeons and all the team that works with these patients at the hospital.

4. One year mortality after surgery in older patients with hip fractures is about 21% in southern Spain. Men sex, cognitive impairment, high Charlson index score, NWB status and change of residence were associated with long term mortality when adjusted by age, pre-fracture functional level, and type of fracture. It is necessary to increase the surveillance of these profile patients.

9.

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10.

Annexes

Annex 1. Informed consent form

Título del proyecto:

Consecuencias de la fractura de cadera sobre la funcionalidad de los sujetos que la sufren.

La fractura de cadera constituye hoy día un problema de salud pública por su elevada frecuencia, su alto riesgo y su alto coste económico. Aunque puede suceder a cualquier edad, el 90% de dichas fracturas ocurren en sujetos mayores de 65 años.

La repercusión que este tipo de fractura tiene sobre la vida de la persona es importante ya que produce un notable cambio en el desarrollo de sus tareas cotidianas y por tanto en su estilo de vida y en el de sus familiares, llegando en ocasiones a provocar un cambio en el domicilio del sujeto que la sufre.

El presente estudio tiene como finalidad determinar el grado de dependencia funcional que adquiere un sujeto tras sufrir una fractura de cadera, y su evolución durante los 12 meses posteriores a la intervención quirúrgica. Y analizar las posibles variables que puedan influir en el período de recuperación tras la intervención.

Para ello será necesaria la colaboración de los sujetos que la padecen y los cuidadores principales, para facilitar la descripción de la situación que presentan, tras la intervención quirúrgica, en relación al desempeño de las Actividades de la Vida Diaria y de la deambulación. Del mismo modo, será necesaria la consulta de la Historia Clínica del paciente con el fin de determinar la influencia que otras variables pueden tener sobre la situación de dependencia funcional de la persona.

Yo, D……..con DNI:……

He leído la hoja de información al paciente que se me ha entregado. He podido hacer preguntas sobre el estudio. He recibido suficiente información sobre el estudio y finalidad del mismo. He hablado con el investigador y/o médicos responsables. Comprendo que mi participación es voluntaria y que puedo retirarme del estudio cuando quiera, sin tener que dar explicaciones y sin que esto repercuta en mis cuidados médicos.

Doy mi consentimiento voluntario para participar en este estudio y me comprometo a colaborar en la cumplimentación de los cuestionarios y entrevistas que se me realicen.

Asimismo, conforme a la Ley Orgánica de Protección de Datos de Carácter Personal 15/1999, de 13 de diciembre, autorizo al grupo de investigación al uso reglamentario de mis datos con fines de investigación y reservándome los derechos de acceso, rectificación, cancelación y
oposición de los mismos.

Firma del sujeto Firma del investigador

Jaén a…..de.....de 2009

Annex 2. Data collection forms

Cuestionario Fractura de Cadera

Tiempo_____

1.Datos sociodemográficos

Nº de cuestionario_____ **Fecha cumplimentación** _____

Apellidos_____ **Nombre**_____

Nº Hª Clínica_____ **Fecha de nacimiento**_____ **Edad**_____

Sexo:

1. Hombre_____
2. Mujer_____

Teléfonos (paciente y familiar)_____

Talla_____ **Peso**_____

Nivel de estudios:

1. No sabe leer y escribir_____
2. Sin estudios, pero sabe leer y escribir_____
3. Estudios primarios _____
4. Estudios secundarios, Bachiller, FP_____
5. Estudios universitarios _____

Dominancia del paciente:

1. Diestro____
2. Zurdo _____
3. Ambidiestro____

2. Datos clínicos

Riesgo quirúrgico

1. Nivel 1_____
2. Nivel 2_____
3. Nivel 3_____
4. Nivel 4_____
5. Nivel 5_____

Comorbilidad:

1. HTA □ Si □ No
2. Depresión □ Si □ No
3. Parkinson □ Si □ No
4. Demencia □ Si □ No
5. Infarto miocárdico □ Si □ No
6. Insuficiencia cardiaca □ Si □No
7. Enf. Vascular periférica □ Si □ No
8. Enf. Vascular cerebral □ Si □ No
9. Enf. Pulmonar crónica □ Si □ No
10. Enf. Tejido conectivo □ Si □ No
11. Ulcera péptica □ Si □ No
12. Hepatopatia leve □ Si □ No
13. Diabetes Mellitas □ Si □ No
14. Hemiplejia □ Si □ No
15. Diabetes con afect orgánica □ Si □ No
16. Insufic renal, mod o grave □ Si □ No
17. Cáncer, leucemia, linfoma □ Si □ No
18. Hepatopatía □ Si □No
19. Cáncer con metástasis □ Si □ No
20. SIDA □ Si □ No
21. Otros_____

Dispositivos o ttº complementarios:

1. Marcapasos □ Si □ No
2. Antiagregantes/Anticoagulantes □ Si □ No
3. Portador de sonda □ Si □ No
4. Otros_____

Complicaciones postquirúrgicas:

1. Infección de la herida □ Si □ No
2. Aflojamiento □ Si □ No
3. Luxación □ Si □ No
4. Trombosis □ Si □ No
5. Estreñimiento □ Si □ No
6. UPP □ Si □ No
7. Desorientación □ Si □ No
8. Caídas □ Si □ No
9. Infec nosocomiales □ Si □ No
10. Otras _____

Miembro fracturado:

1. Derecho____
2. Izquierdo___

Tipo de fractura:

1.Intracapsular subcapital _____
2.Intracapsular transcervical _____
3.Intracapsular basicervical _____
4.Extracapsular Pertrocantérea_____
5.Extracapsular persubtrocantérea_____
6. Extracapasular subtrocantérea

Carga en miembro afecto al alta hospitalaria:

1. Si_____
2. No____

Ayuda técnica al alta:

1. Silla de ruedas ____
2. Andador ____
3. Muletas ____
4. Ninguna ____

Salud autopercibida:

1. Muy buena_____
2. Buena_____
3. Regular_____
4. Mala_____
5. Muy mala_____

Tipo de intervención:

1. Tornillo-placa ____
2. Prótesis parcial ____
3. Clavo gamma____
4. Otros_____

Tipo de cirugía:

1. Programada ____
2. De urgencia ____
3. Otras_____

Reingreso:

1. Si ____
2. No ____

Causa del reingreso:

1. Fractura periprotésica____
2. Infección de la herida ____
3. Otras ____

Fractura contralateral:

1. Si_____
2. No_____

Otra fractura asociada:

1. Si_____
2. No_____

Deterioro Cognitivo:

Puntuación escala de Pfeiffer_____

Estado emocional:

Puntuación escala de ansiedad-depresión de goldber _____

Dolor:

Puntuación escala analógica-visual_____

3. Datos asistenciales

Estancia hospitalaria:

Fecha de ingreso_____
Fecha de alta_____
Fecha de intervención quirúrgica_____

Nº Sesiones de Rehabilitación durante ingreso y fecha de inicio de rehabilitación:

Fecha_____ Nº_____

Duración de las sesiones durante el ingreso:

Tiempo en minutos_____

4. Datos sociales

Lugar de Residencia previo a la fractura de cadera:

1. Domicilio propio y vive solo_____
2. Domicilio propio y no vive solo_____
3. Domicilio de un familiar_____
4. Institución_____

Lugar de Residencia tras alta hospitalaria:

1. Domicilio propio_____
2. Domicilio propio y no vive solo_____
3. Domicilio de un familiar_____
4. Institución_____
5. Defunción hospitalaria_____

Ayudas personales tras alta

1. Cuidador formal _____
2. Cuidador informal _____

Composición familiar

Índice de esfuerzo del cuidador Puntuación_____

5.Datos funcionales

Nivel de dependencia funcional (MIF):

	Previo fractura	Sedestación / Bipedestación
PUNTUACIÓN		

Cuestionario al mes post-intervención

2. Datos clínicos

Uso de alguna Ayuda técnica:

1. Silla de ruedas_____
2. Andador_____
3. Muletas_____
4. Ninguna_____

Salud autopercibida:

1. Muy buena_____
2. Buena_____
3. Regular_____
4. Mala_____
5. Muy mala_____

Deterioro Cognitivo

Puntuación escala (Pfeiffer)_____

Estado emocional

Puntuación escala de ansiedad-depresión de goldber _____

Dolor:

Puntuación escala analógica-visual_____

3. Datos asistenciales

Nº Sesiones de Rehabilitación tras alta hospitalaria y fecha de inicio de rehabilitación:

Fecha_____

Nº: < 7 sesiones _____
7-14 sesiones_____
14-21 sesiones ____

Duración de las sesiones tras alta hospitalaria.

Tiempo en minutos_____

4. Datos sociales

Lugar de Residencia en el momento actual:

1. Domicilio propio y vive solo_____
2. Domicilio propio y no vive solo_____
3. Domicilio de un familiar_____
4. Institución_____

Composición familiar:

Índice de esfuerzo del cuidador

Puntuación_____

5. Datos funcionales

Nivel de dependencia funcional (MIF):

	1 mes post-intervención
PUNTUACIÓN	

Marcha (escala de Tinetti):

	1 mes post-intervención
PUNTUACIÓN	

Equilibrio (escala de Tinetti):

	1 mes post-intervención
PUNTUACIÓN	

Cuestionario a los 3 meses post-intervención

2. Datos clínicos

Uso de alguna Ayuda técnica:

1. Silla de ruedas_____
2. Andador_____
3. Muletas_____
4. Ninguna_____

Salud autopercibida:

1. Muy buena_____
2. Buena_____
3. Regular_____
4. Mala_____
5. Muy mala_____

Estado emocional (Goldberg):_____ **Deterioro Cognitivo (Pfeiffer): _____**

Dolor (Puntuación escala analógica-visual): _____

Tranporte al hospital según protocolo (ambulancia medicalizada): □Si □No

Medicación Previa Fractura (Corticoides) :_____ □Si □No

Lugar caída: 0. □Domicilio 1. □Calle **Complicaciones:_____**

3. Datos asistenciales

Nº Sesiones de Rehabilitación tras alta hospitalaria y fecha de inicio de rehabilitación:

Fecha_____ Nº: < 7 sesiones _____
7-14 sesiones_____
14-21 sesiones ____

Duración de las sesiones tras alta hospitalaria (Tiempo en minutos): _____

4. Datos sociales

Lugar de Residencia en el momento actual:

1. Domicilio propio y vive solo_____
2. Domicilio propio y no vive solo_____
3. Domicilio de un familiar_____
4. Institución_____

Composición familiar:_____

5. Datos funcionales

Nivel de dependencia funcional MIF):_____
Marcha (escala de Tinetti):_____
Equilibrio (escala de Tinetti):_____

6. Cuidador

Nº Cuidadores_____

Cuidador Principal:

Sexo: 0.Hombre_____ 1.Mujer___
Edad:_____
Activo: □ Si □No

Dificultades en el domicilio:

a. En el manejo del paciente en la cama y en las transferencias □Si □ No
b. En los cuidados del paciente (aseo, vestido, etc) □Si □ No
c. En la deambulación □Si □ No
d. Otras_____

¿Qué mejoraría en la asistencia?

1. Educación Sanitaria relativa al manejo del paciente_____
2. Educación Sanitaria relativa a los cuidados del paciente___
3. Rehabilitación_____
4. Seguimiento_____
5. Información sobre servicios sociales y ayuda a domicilio____
6. Otros_____

Cuestionario al año post-intervención

1. Datos clínicos

Uso de alguna Ayuda técnica:

5. Silla de ruedas_____
6. Andador_____
7. Muletas_____
8. Ninguna_____

Salud autopercibida:

9. Muy buena_____
10. Buena_____
11. Regular_____
12. Mala_____
13. Muy mala_____

Estado emocional (Goldberg):_____

Rehabilitación: 1.□ Pública 2.□ Privada

Otras intervenciones quirúrgicas en el año: 1.□Si 2. □No

Complicaciones._____

2. Datos sociales

Lugar de Residencia en el momento actual:

14. Domicilio propio y vive solo_____
15. Domicilio propio y no vive solo_____
16. Domicilio de un familiar_____
17. Institución_____

Ayudas sociales:

1. Cuidador (Horas)_____
2. Económica_____
3. Centro de día____
4. Residencia_____
5. Ninguna_____

3.Datos funcionales

Nivel de dependencia funcional MIF):_____
Marcha (escala de Tinetti):_____
Equilibrio (escala de Tinetti):_____

Annex 3. Conference papers

Presented at the 13th EFORT Congress 2012. Berlin.

Non weight-bearing status compromise the 1-year functional outcome of patients with hip fracture

Ariza Vega P, Jiménez-Moleón JJ, Kristensen MT

Introduction: Nowadays most patients are allowed weight bearing (WB) as tolerated immediately after hip fracture surgery in northern Europe (95% with no surgical restrictions of WB), but this is not as common in other parts of Europe. Still, there is a lack of knowledge about the influence of this, in relation to the long-term functional outcome.

Objectives: To examine the influence of non-WB status after hip fracture surgery to the 1-year functional outcome

Methods: A total of 275 consecutive patients admitted within one year in a regional hospital in Spain, were available for the study. Of these, 17 had other fractures, 18 were had surgical complications, 43 died, and 3 withdrew from the study before the 1-year follow up, leaving 194 patients with a mean (SD) age of 81.4 (6.1) for final analysis. Respectively, 22 (24%) out of 91 with a cervical fracture, and 53 (51%) out of 103 with a trochanteric fracture were not allowed WB for a period of two to four weeks after surgery. The prefracture and 1-year functional level was evaluated with the Functional Independence Measure (18-126 points, high scores indicate a high level of independence), cognitive status with the Pfeiffer score (1-10 points), and health status with the American Society of Anaesthesiologists (ASA) rating (1-5). Residential status was classified as own home, relatives home, or nursing home.

Results: Simple regression analysis showed age, prefracture level, cognition, health and residential status, in addition to the WB status, significantly influenced the 1-year functional outcome ($P \leq 0.028$), while sex ($P=0.2$), fracture type ($P=0.052$), and time to surgery in days, did not ($P \geq 0.2$). Multiple linear regression analysis revealed WB status, prefracture functional level, age, and cognitive status ($P<0.001$), in addition to the health status and fracture type ($P \leq 0.035$), as independent predictors of the 1-year functional outcome, when adjusted for sex, time to surgery and residential status. Thus, a patient with a non-WB status, a low prefracture function (FIM < 91 points), cognitive impairment (Pfeiffer score 5-10) and/or a low health status (ASA rating 3-5) had, on average, FIMtotal scores that were respectively 14, 25, 22, and 7 points lower, when compared to a patient allowed WB, with a high prefracture function, no cognitive impairment and/or a high health status. Further, a patient with a trochanteric fracture scored on average 10 FIM total points higher than one with a cervical fracture, while scores decreased with 11 points per decade patient's age.

Conclusion: The WB status after surgery, in addition to the prefracture function, cognitive and health status, age and fracture type were found as independent predictors of the 1-year functional outcome, in patients with hip fracture. The orthopedic surgeons ought to evaluate whether more patients could be allowed WB after surgery, while clinicians focusing on the other influencing variables, have the possibility to identify patients who may benefit from special attention.

Key words: Hip fracture, weight bearing, prediction, function.

Presented at the 14th EFORT Congress 2013. Istanbul.

Predictors of 1-year mortality in elderly hip fracture patients in the south of Spain.

Ariza Vega P, Kristensen MT, Jiménez-Moleón JJ

Introduction: The increased risk of death after hip fracture is recognised in the literature, with 1-year mortality ranging from 22 to 30% depending on geographical location. However there is not conclusive information regarding mortality rates and the associated risk factors in South European countries.
Objectives: To determine one year mortality and predisposing factors in elderly hip fracture patients in southern Spain.
Methods: This was a prospective cohort study of 298 patients, 65 years and older, admitted with a hip fracture to an acute hospital trauma service. Data were collected from medical charts and by interviews with patients and/or their relatives. The comorbidity was evaluated with the Charlson Index, the prefracture functional level with the Functional Independence Measure (18-126 points), cognitive status with the Pfeiffer score (1-10 points), and health status with the American Society of Anaesthesiologists rating (1-5). Residential status was classified as own home or relatives home versus nursing home. Seventeen patients who died before surgery and six who died within 24 hours after surgery were included in mortality rates. These 23 patients were not included in Cox regression analysis due to their relatives not being available to sign the informed consent. Accordingly, Cox regression analysis to know associated factors to mortality were calculated for 275 patients.
Results: The 1-year mortality for the 298 patients was 25.5%. The mean (SD) age of the 275 patients with complete data was 81.4 (6.8) years and 216 (79%) were women. Five risk factors and one protective factor were identified by Cox proportional hazard model; male gender (adjusted hazard ratio [HR]= 2.75, 95% confidence interval [CI]=1.44-5.27), cognitive impairment (HR 2.08, CI 1.07-4.05), a high Charlson index score (HR 1.19, CI 1.03-1.38), a low health status (HR 2.35, CI 1.07-5.14), discharged to a nursing home (HR 2.87, CI 1.29-6.41) and living in a nursing home before fracture (HR 0.31, CI 0.11-0.86), when adjusted by age, time to surgery, prefracture functional level, type of fracture, weight-bearing status, medical or surgical complications and length of stay at hospital.
Conclusion: Men and those who have cognitive impairment, low health status, more comorbidities, living with relatives or in their own home before the fracture and who went to live in a nursing home at discharge, had a higher risk of death during the first year after hip fracture surgery in the south of Spain. Our results are consistent with those of other reports[1,2], except that age was not a risk factor in our sample. In addition living in a nursing home prior to fracture was a protective factor of death in our study. This could be explained by the care structure in our region, where patients usually are cared by relatives instead of being in a nursing home, although they are quit frail. More efforts should be carried out to prevent this pathology and to improve the postoperative care in this population.
Key Words: Hip fracture. Risk factors. Mortality.

Annex 4. Papers I-III

Paper I: Change of residence and functional status within three months and one year following hip fracture surgery

Paper II: Non Weight-Bearing Status Compromises the Functional Level up to 1-Year after Hip Fracture Surgery

Paper III: Predictors of long term mortality in elderly hip fracture patients

Change of residence and functional status within three months and one year following hip fracture surgery

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RESEARCH ARTICLE

Change of residence and functional status within three months and one year following hip fracture surgery

Patrocinio Ariza-Vega[1,2], José Juan Jiménez-Moleón[3,4], and Morten Tange Kristensen[5,6,7]

[1]Rehabilitation and Traumatology Service, Virgen de las Nieves Hospital, Granada, Spain, [2]Department of Physiotherapy and [3]Department of Preventive Medicine and Public Health, University of Granada, Granada, Spain, [4]CIBER Epidemiología y Salud Pública (CIBERESP), Granada, Spain, [5]Physical Medicine and Rehabilitation Research – Copenhagen (PMR-C), [6]Department of Physiotherapy, and [7]Department of Orthopaedic Surgery, Copenhagen University Hospital Hvidovre, Denmark

Abstract

Purpose: To study the recovery of patients in terms of 18 activities of daily living and change of residence within the year following a hip fracture. *Method*: This prospective cohort study was carried out in a trauma service of an acute hospital in southern Spain including 159 patients with a hip fracture, 65 years or older and allowed weight-bearing after surgery. Patients or their relatives were interviewed about their residential status and functional level at pre-fracture, three months and one year after surgery, using the Functional Independence Measure. *Results*: Losses of function for the main activities affected were, at the first month, third month and one year relative to the pre-fracture status, 50%, 25% and 12%, respectively, for locomotion, 40%, 25% and 20%, respectively, for mobility and 27%, 17% and 15%, respectively, for self care ($p < 0.001$). Residential status changed mostly for patients who lived in their own home (73% before fracture to 58% at one year). *Conclusions*: The loss of independence in the first year after a hip fracture is substantial for specific activities. Recovery mainly takes place during the first three months after surgery. Change of residence mostly involved those patients who lived alone in their own home at pre-fracture.

➤ Implications for Rehabilitation

- One year after fracture, patients did not recover their previous function, and the activities most affected at the one-year follow-up were: dressing lower body, bathing/showering, transfer bathtub/shower and walking up/down stairs.
- After a hip fracture, most recovery of the function happens within the first three months, though some functional activities continue recovering over the first year.
- Rehabilitation programs cannot be based only on mobility activities, the recovery of other daily living activities should also be included.

Keywords

Function, hip fracture, recovery

History

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Introduction

Hip fracture is a major public health problem in the elderly because of its high incidence, the high related mortality and morbidity, the loss of functional independence, the subsequent diminished quality of life and the burden of care involved [1–5]. Increased mortality in the first year after fracture reportedly ranges from 18 to 33% [6–9], whereas declines in functional status are of the order of 29% for ''fine motor skills'' to 56% for mobility overall. Only a third of patients recover their previous level of activities of daily living (ADL) at one year following a hip fracture [8–10]. The loss of independence entails major family, institutional and social adjustments [11], one reason being that hip fracture can mean a change of residence or institutionalized care among elderly people [8,12].

After reduction of morbidity and mortality, the foremost therapeutic goals in treating patients who have surgery after a hip fracture are reduction of the fracture and prevention of vascular necrosis. However, clinicians could have more ambitious aims, such as returning patients to their pre-fracture functional level as quickly as possible, and enabling them to maintain or return to their previous social setting [13]. To this end, it is important to establish an optimal time for the follow-up of these patients, based on some knowledge of the specific activities that take longer to resume at the previous level [14–18]. In northern Europe, recovery time may take from four months to over 12 months [19]. In Spain and other countries of southern Europe such as Portugal, there are few studies about functional recovery after a hip fracture, and there are often weaknesses in these studies, such as a retrospective design [20], analysis of a reduced number of functional activities [13,20] or a short follow-up period [10,20]. Quantifying the optimal recovery time of functional activities

Address for correspondence: María Patrocinio Ariza Vega, PhD student, Department of Preventive Medicine and Public Health, University of Granada, Rehabilitation and Traumatology Virgen de las Nieves University Hospital, Carretera de Jaén s/n, 18013, Granada, Spain. Tel: 0034 958021596. E-mail: pariza@hotmail.com

calls for conducting studies with adequate validity. Furthermore, the loss of functional level may influence residential status as suggested in previous studies [8,12]. This aspect probably depends on the care/support system involved, which apparently differs among countries. In Spain, where there are typically no specific inpatient rehabilitation settings in the wake of acute hospital discharge, and where most care is provided by the patient's family, there is a lack of knowledge about the effect of hip fracture on residential status.

The objectives of this study were therefore to examine, in the context of southern Spain, (1) the recovery of function in terms of 18 ADL items and (2) the change of residence, at one month, three months and one year after hip fracture surgery. It is our belief that clinicians might design better rehabilitation strategies and treatment programmes in view of the time periods needed to improve the outcome of those activities most affected.

Materials and methods

We carried out a prospective cohort study of all patients with an acute hip fracture admitted to the Traumatology Service of Jaen Hospital in southern Spain between January 2009 and January 2010. The hospital covers a population of around 350 000 people. The patients included met the following criteria: (1) being 65 years or older; (2) accepting to participate in the study, signing an informed consent form; (3) allowing weight-bearing as tolerated after surgery; and (4) absence of a terminal disease. For patients with cognitive impairment, the closest relative or caregiver signed the informed consent. The ethics committee of the Jaen Hospital approved the study.

A total of 178 patients with hip fracture fulfilled the inclusion criteria. Of the 178 patients, six died immediately after surgery, and data on 13 patients was not available, leaving 159 patients for inclusion in the study.

Procedures and follow-up

Clinical data regarding the length of hospital stay, type of fracture, type of surgery, need of personal assistance at discharge, using wheelchair or walking aids at discharge and surgery risk/health status – measured with the American Society of Anaesthesiologists [21] score of 1–5 points – were taken from the patients' medical records.

Sociodemographic data, weight and height (body mass index), residential status, place of the fall, the cognitive level (measured by the Pfeiffer scale, 0–10 points) [22,23], and the discharge destination were recorded during an interview with the patient, their relatives or their caregiver.

Furthermore, the functional level a week before the hip fracture, using the Functional Independence Measure (FIM) [24], was recorded during this interview. It was followed by interviews at one month, three months and one year after surgery.

The first interview (regarding the pre-fracture level) took place during the hospital stay after surgery, while the second and third interviews were at the hospital coinciding with Traumatology revisits. The last interview was done by telephone at the end of one year. Information was collected through a structured face-to-face questionnaire, managed by one experienced therapist–interviewer. The medical records were usually reviewed on the day of the interview.

Rehabilitation

The in-hospital rehabilitation included upper body exercises, early strengthening and weight bearing exercises and early assisted ambulation. In Spain, physiotherapy usually begins during the first week after surgery; patients are normally referred to outpatient rehabilitation facilities in the municipality, though some patients receive rehabilitation at home. The outpatient physiotherapy includes strength and balance exercises and training to climb stairs. Patients who are discharged to a nursing home receive physiotherapy and occupational therapy at the nursing home, usually five days a week, for some months after discharge from the hospital.

The FIM

The FIM, our main outcome variable, has six categories with a total of 18 items, 13 of them corresponding to physical domains and 5 to cognitive ones. The items, scored according to the level of assistance required for an individual to perform ADL are as follows: (1) self-care: eating, grooming, bathing/showering, dressing upper body, dressing lower body and toileting; (2) sphincter control: bladder management and bowel control; (3) mobility: transfer bed–chair–wheelchair, transfer toilet and transfer bathtub–shower; (4) Locomotion: walking–wheelchair and stairs; (5) communication: expression and comprehension; and (6) cognition-problem solving: social interaction, problem solving and memory. Each item is scored from 1 to 7 based on the level of independence, where 1 represents total dependence, 2 maximum assistance from another person (subject provides less than half of the effort), 3 moderate assistance from another person (subject performs 50–75% of the task), 4 minimum assistance requiring incidental hands-on help only (subject performs >75% of the task), 5 supervision requiring only standby assistance or verbal prompting or help with set-up, 6 modified independence (subject requires the use of technical assistance but no physical help) and 7 indicates complete independence. FIM total score ranges from 18 to 126 points, the higher scores indicating a higher level of independence. Based on the FIM total score, we constructed a new variable to categorize the level of independence as either *need for some type of personal assistance* for FIM values from 18 to 90 (assuming a score of 5 or below for each item of the scale) or *independent*, when FIM values were between 91 and 126 (a score of six or seven for each item). The FIM is well validated for patients with hip fracture [24–26] and during stroke rehabilitation [27].

Statistical analysis

The Chi-square test was used for analysis of change in residential status and other categorical data and presented as a number with a percentage. Continuous data were analysed with the Student *t*-test, if normally distributed, while the Mann–Whitney or Wilcoxon signed ranks test was used for non-normally distributed data, and based on the Kolmogorov–Smirnov test. Comparison of the FIM total and the six categories at the different time points from pre-surgery to one year after surgery was done using the Friedman test for repeated measures of non-parametric data. If significant, the Wilcoxon test was performed to examine differences, with Bonferroni adjustments to minimize the risk of Type 1 error; this gave a p value of $p < 0.01$ for the five comparisons ($p < 0.05/5 = 0.01$). In addition, the proportion of patients who recovered their pre-fracture functional level was calculated, with the pre-fracture level set at 100%. Finally, we calculated the change in the number of patients able to function without assistance from another person (scoring 6 or 7) when performing specific items. Data are presented as a number with a percentage, as means (with standard deviation) or as median (with 25–75% quartiles), as appropriate. A two-sided probability level of 0.05 or less was deemed to indicate statistical

significance. Data were analyzed using the statistical programme SPSS Version 15.0 (SPSS Inc., Chicago, IL).

Results

Characteristics of the 159 patients (120 women; 76%) with a mean age of 81.2 years (SD: 6.6) are presented in Table 1. Five participating patients died within the first month after surgery, seven between the first and the third month and 10 between the third month and the first year. Moreover, one patient was lost after the third month, leaving 135 elderly patients to be followed during the entire study period of one year.

Scores for the total FIM and the six categories for patients alive at the different time points from pre-fracture to the one year follow-up showed that the total FIM score decreased from a median of 114 (94–124) points to 89 (60–101) at one month, then increased to medians of 99 and 105 points at three months and 1 year, respectively. The ''mobility'' category was the most significantly affected (Table 2).

Repeated measures analysis showed significant differences ($p < 0.01$) for total FIM scores: pre-fracture to one month, pre-fracture to three months, pre-fracture to 1-year, 1–3 months and 3 months to 1 year (Table 3). Moreover, significant differences were seen for the categories self care, mobility and locomotion, for the same comparisons as above (Table 3).

Although the capacity for locomotion was the most affected at short term – with a 50% loss of capacity at one month and 25% at the three month follow-up – this was the area where the greatest recovery was seen after one year (Table 3). The evolution of self-care showed 27, 17 and 15%, respectively ($p < 0.001$), and for mobility the values were 40, 25 and 20% ($p < 0.001$) (Table 3).

It is noteworthy that the number of independent patients (scoring 6 or 7 points) from pre-fracture to one year post surgery dropped from 55 to 33% for bathing/showering, 73 to 42% for dressing lower body, 85 to 67% for toileting, 89 to 65% for transfer bed/chair, 85 to 67% for transfer toilet, 56 to 30% for transfer bathtub/shower and from 67 to 43% for walking up/down stairs.

Table 1. Demographic and clinical characteristics of patients.

Variables	Categories	$N = 159$
Age in years		81.2 (6.6), 65–100
Sex	Female	120 (76)
Residence before fracture	Presented in Table 4	
Body mass index, $n = 158$[a]	$\leq 25\ kg/m^2$	69 (43)
	$> 25\ kg/m^2$	89 (56)
American Society of Anaesthesiologists score	1 or 2 = high health status	60 (38)
	3–5 = low health status	99 (62)
Pfeiffer score (cognitive), $n = 145$[a]	0–4 = no impairment	106 (67)
	≥ 5 moderate to high impairment	39 (24)
Place of the fall, $n = 147$[a]	Indoor	110 (69)
	Outdoor	37 (23)
Type of fracture	Intracapsular fracture	95 (60)
	Extracapsular intertrochanteric	54 (34)
	Extracapsular subtrochanteric	10 (6)
Time from admission to surgery	Within 24 h	84 (53)
	Later than 24 h	75 (47)
Type of surgery	Hemiarthroplasty	76 (48)
	Dynamic hip screw with plate	70 (44)
	Intra medullar hip screw	13 (8)
Length of hospital stay in days		13.5 (10.4), 5–94
Aid at discharge	Wheelchair	4 (3)
	Walker	153 (96)
	Crutches	2 (1)
Discharge destination	Own home not alone	92 (58)
	Relative's home	42 (26)
	Nursing home	25 (16)
Assistance at discharge, $n = 157$[a]	Formal caregiver	38 (24)
	Informal caregiver (family)	119 (75)
Rehabilitation sessions within 3 months of discharge, $n = 145$[a]	Yes	94 (59)
	No	51 (32)

Data are number with (percentage) or mean with (standard deviation), range.
[a]Due to missing data.

Table 2. Evolution of the total functional independence measure (FIM) and for each of the six categories, from pre-fracture to one-year after hip fracture.

	Pre-fracture $n = 159$	One month $n = 154$	Three months $n = 147$	One year $n = 135$
Total FIM (18–126)	114 (94–124)	89 (60–101)	99 (72–115)	105 (82–118)
Self care (6–42)	40 (33–42)	28 (17–33)	33 (23–38)	34 (28–40)
Sphincter control (2–14)	12 (9–14)	11 (8–14)	12 (9–14)	12 (9–14)
Mobility (3–21)	20 (15–21)	11 (6–14)	15 (11–17)	16 (13–18)
Locomotion (2–14)	12 (9–14)	3 (6–18)	9 (6–12)	11 (7–13)
Communication (2–14)	14 (10–14)	13 (10–14)	13 (11–14)	13 (11–14)
Cognition (3–21)	20 (15–21)	19 (13–21)	19 (13–21)	19 (1–21)

Data are presented as median with (25–75% quartiles).

Table 3. Recovery of function for patients alive at one year ($n = 135$).

	Pre-fracture	One month	Three months	One year
Total FIM (18–126)[a,b]	115 (98–125)	90 (65–102); 78[c]	100 (79–115); 87[d]	105 (82–118); 91[e]
Self care (6–42)[a,b]	40 (35–42)	29 (20–34); 73	33 (26–38); 83	34 (28–40); 85
Eating	7 (7–7)	7 (6–7)	7 (7–7)	7 (7–7)
Grooming	7 (7–7)	6 (4–7); 86	7 (4–7)	7 (5–7)
Bathing/showering	6 (3–7)	2 (2–3); 33	3 (2–3); 50	4 (3–6); 67
Dressing upper body	7 (6–4)	6 (3–7); 86	6 (4–7); 86	6 (4–7); 86
Dressing lower body	7 (5–7)	3 (2–4); 43	4 (3–6); 57	4 (4–7); 57
Toileting	7 (6–7)	5 (2–6); 71	6 (4–6); 86	6 (5–6); 86
Sphincter control (2–14)[a]	13 (10–14)	12 (9–14); 92[c]	12 (9–14); 92[d]	12 (9–14); 92[e]
Bladder management	6 (3–7)	5 (3–7); 83	5 (3–7); 83	5 (3–7); 83
Bowel management	7 (6–7)	7 (6–7)	7 (6–7)	7 (6–7)
Mobility (3–21)[a,b]	20 (16–21)	12 (8–15); 60	15 (12–17); 75	16 (13–18); 80
Transfer bed/chair	7 (6–7)	4 (3–6); 57	6 (4–6); 86	6 (5–6); 86
Transfer toilet	7 (6–7)	5 (3–6); 71	6 (4–6); 86	6 (5–6); 86
Transfer bathtub/shower	6 (4–7)	2 (2–3); 33	4 (2–5); 67	4 (3–6); 67
Locomotion (2–14)[a,b]	12 (9–14)	6 (3–8); 50	9 (6–12); 75	11 (7–13); 92
Walking/wheelchair	7 (6–7)	5 (3–6); 71	6 (5–6); 86	6 (5–7); 86
Stairs	6 (4–7)	1 (1–3); 17	4 (1–6); 67	5 (1–6); 83
Communication (2–14)	14 (10–14)	14 (10–14)	13 (11–14); 93	13 (11–14); 93
Understanding	7 (6–7)	7 (6–7)	7 (6–7)	7 (6–7)
Expression	7 (5–7)	7 (5–7)	6 (5–7); 86	6 (5–7); 86
Cognition (3–21)[a]	20 (16–21)	20 (14–21)[c]	19 (14–21); 95[d]	19 (13–21); 95[e]
Social interaction	7 (7–7)	7 (6–7)	7 (6–7)	7 (6–7)
Problem solving	7 (3–7)	6 (3–7); 86	6 (2–7); 86	6 (2–7); 86
Memory	7 (6–7)	7 (5–7)	7 (5–7)	7 (5–7)

Data are presented as median with (25–75%, quartiles) and percentage of the pre-fracture level, (e.g. one-month/pre-fracture) × 100.
[a]Friedman repeated measures analysis; $p < 0.001$. Wilcoxon with Bonferroni corrections $p < 0.01$.
[b]All the following comparisons.
[c]Pre-fracture/one month.
[d]Pre-fracture/three months.
[e]Pre-fracture/one year, one month/three months, three months/one year.

Table 4. Residential status at pre-fracture and one year after hip fracture.

		1-year, n=135				
Pre-fracture	Pre-fracture status $N = 159$	Own home alone	Own home not alone	Home of relative	Nursing home	Pre-fracture status, survivors $n = 135$
Own home, alone	34 (21.4)	8 (5.9)	8 (5.9)	7 (5.2)	5 (3.7)	28 (20.7)
Own home, not alone	82 (51.6)	2 (1.5)	59 (43.7)	7 (5.2)	1 (0.7)	69 (51.1)
Home of relative	30 (18.9)	1 (0.7)	1 (0.7)	24 (17.8)	2 (1.5)	28 (20.7)
Nursing home	13 (8.2)	0 (0)	0 (0)	0 (0)	10 (7.4)	10 (7.4)
Residence at one year		11 (8.1)	68 (50.4)	38 (28.1)	18 (13.3)	135

Data are presented as number of patients with (percentage).

As regards the residential status, 73% of the whole sample lived in their own home before the fracture, 21% of them living alone (Table 4). One year later, this changed to 59% of patients living in their own home (only 8% alone), and more patients were living with relatives or in a nursing home (Table 4).

Patients who received outpatient rehabilitation within three months ($n = 87$; 64%), ranging from less than seven sessions ($n = 9$) to more than 21 ($n = 30$) had better FIM total scores at three months and at one year, with respective medians of 101 (86–116; $p = 0.02$) and 107 (86–118; $p = 0.06$), as opposed to those without rehabilitation, showing medians of 93 (61–113) and 95 (70–116).

The level of functional independence one year after the hip fracture was found to be associated with the cognitive status. Thus, 85.5% of the patients without cognitive impairment (Pfeiffer score ≤ 4) could be considered independent (no need for some type of personal assistance) versus 57.3% of the patients with some grade of cognitive impairment ($p < 0.001$). We should state that most of our patients (73.1%) had some level of cognitive impairment (Pfeiffer score > 4). On the contrary, the one-year functional independence level was not significantly associated with residential status or the delay to surgery.

Discussion

This descriptive study of changes in functional status following hip fracture provides evidence that (1) functional recovery was not achieved in all the ADL items within one year of fracture for most of the patients of the study, (2) there were differences in the time required to regain functionality in the activities analysed and (3) a significant number of patients had to change their residential status within one year following the hip fracture.

Functional recovery

Total FIM scores suggest that loss of function should be considered a minor problem for patients alive one year after a hip fracture, if living in southern Spain. That is, the median loss of function for survivors was only 9% in our study, as compared to a mean loss of function of 21% in a British study [1], and especially when compared to a Portuguese study reporting that

more than 75% of patients became totally dependent after hip fracture [11]. A previous study of hip fracture in a Spanish population reported a mean functional loss of 19% six months afterwards, yet it only included patients who had no cognitive impairment and were independent in ADLs before the fracture [10].

Findings from this study underline the importance of not just relying on results gained from total ADL scores, however. The loss of function was higher in certain categories of the FIM, and especially in important activities related to independence, or to recovery of the pre-fracture level of independence. Transfer from bathtub/shower, dressing lower body and walking up/down stairs were only reached, respectively, by 54, 58 and 64% of patients; and rates of independence at one year for these items were just 30, 42 and 43%. These findings are in line with those of a similar study looking into recovery for activities such as transfer (60%) and climbing stairs and bathing (68%) at one year [13]. In contrast, a Finnish study reported as many as 68% of patients were independent in bathing/showering, and 79% at dressing, one year following fracture [19]. Interestingly, these Finnish patients stayed only 7.7 d on an average in the acute hospital setting [19] as compared to a mean of 13.5 d in this study and other Spanish studies [10,13]. Our patients were discharged to their own home, to relatives or a nursing home and continued rehabilitation in outpatient services, in contrast to countries of northern Europe, where patients are usually discharged to inpatient rehabilitation facilities (85% of the patients in the Finnish study). Similarly, in a US study, the mean hospital stay was 7.2 d in hospital, and just 14% were sent home directly after hip fracture [8]; while in a Danish study, 76% of patients admitted from their own home were discharged directly to their own home again, after a median of 11 (8–15) d in the acute hospital [28]. Clearly, from one country to another, there is a variety of healthcare systems and rehabilitation courses following hip fracture, which most likely influences the final outcome. Accordingly, comparison of the rehabilitation provided after discharge from different hospitals reveals great variation, from none at all to more than 21 sessions.

Time to recovery

It was hoped that our results would help us identify the ''most adequate'' time period to follow patients with hip fracture for the evaluation of their functional recovery. Previous studies indicate that most recovery happens within the first four [19] to six months [13], although specific items require recovery over the entire first year [13,19]. Another study proposes that the overall trend of recovery in ADL function is seen at two months of post acute rehabilitation, and continued within six months, after which functional recovery appears to be minimal yet constant throughout the remainder of the first year [29].

Along these lines, we found no recovery beyond three months for activities such as dressing, bladder and bowel management, grooming and eating; yet walking up/down stairs, bathtub/shower transfer and bathing continued to improve from three months to one year (though the pre-fracture level was not reached).

Change of residence

Residential status in southern Spain is somewhat different than in northern European countries, probably because of a different family structure and/or cultural influences. Thus, 19% of our patients resided at the home of a relative and only 8% in a nursing home at pre-fracture, as compared to 31% living in residential or nursing homes in England at pre-fracture [1]. None of the 34 (21%) patients living alone in their own home at pre-fracture were discharged to their home directly from the hospital, and only 8% went back to living alone at one year. Many patients lived in the home of a relative (28%), in contrast to other countries [1,19] with more living in a nursing home and no one at the home of a relative, which again reflects different cultural, social and healthcare systems. Nonetheless, internationally, changes to residential status after a hip fracture are somewhat similar in the sense that more people reside in ''care'' facilities.

Most patients in our study were elderly women, who lived in their own home, with characteristics similar to those of patients included in other studies [1,29,30]. The change of residence and failure to regain the pre-fracture functional level found in this and other studies [1,11,13,19] would suggest that what is considered good treatment for patients with hip fracture is, in fact, insufficient. It may be that more sessions of rehabilitation are needed, with physical and occupational therapy in the post-operative period and the months following discharge, and an evaluation of possible adaptative measures for the place of residence. A study carried out by Hershkovitz et al. showed that 55.4% of hip-fracture patients were unable to maintain their rehabilitation achievements in terms of functional status one year after discharge from the rehabilitation unit [30]. In addition, the cooperation between therapists, geriatricians and orthopaedics appears to be worth recommending, as results are found to be better in patients who follow joint programmes [12,15,31,32].

Limitations of the study

The methodological strengths of our study include its prospective design, the long-term (one year) follow-up period and the use of a well-validated instrument to measure functional outcome. Some limitations must also be addressed, however. The one-year follow-up interview was performed over phone and was on occasion reliant on information supplied by relatives, which may have influenced the results. A similar approach has been used in a previous study [19].

Another limitation is the lack of specific knowledge about the rehabilitation provided, although we do know that it varied considerably from patient to patient. Assessing the rehabilitation techniques used was not the purpose of this study, however, and is also not reported in other follow-up studies [1,13,19]. We recommend that such knowledge be included in future studies.

Conclusion

Most patients who had a hip fracture were independent in the ADLs or required minimal help before their hip fracture. Yet after the surgery, the loss of independence and change of residential status were substantial at the one-year follow-up. The activities affected the most were: bathing/showering and dressing lower body in the ''self-care'' category, transfer bathtub/shower in ''mobility'' and walking up/down stairs in ''locomotion''. The major part of recovery took place during the first three months after surgery, which is the time period when patients would undergo rehabilitation (if having any at all), while a continual but reduced recovery was seen over the subsequent months. However, at the end of the 12-month period of study, most of these patients had not regained their previous level of functioning in these activities, suggesting that the rehabilitation provided was insufficient. Further studies should evaluate if extended rehabilitation could improve the long-term outcome. Moreover, we found that hip fractures often resulted in changes of the place of residence. In the context of southern Spain, as it is common practice for the patient to move in with relatives, this entails a greater burden of care for the relatives.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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Non Weight-Bearing Status Compromises the Functional Level up to 1-Year after Hip Fracture Surgery

II

Non weight-bearing status compromises the functional level up to 1-year after hip fracture surgery

Patrocinio Ariza-Vega[1], MSc, José Juan Jiménez-Moleón[2], PhD, Morten Tange Kristensen[3], Phd.

[1]Department of Rehabilitation, Rehabilitation and Traumatology Virgin de las Nieves University Hospital, Granada, and Department of Physical Therapy, University of Granada, Spain;

[2] Department of Preventive Medicine and Public Health, University of Granada, CIBER of Epidemiology and Public Health, Spain. CIBEResp;

[3] Physical Medicine and Rehabilitation Research – Copenhagen (PMR-C), Department of Physical Therapy and Orthopedic Surgery, Copenhagen University Hospital Hvidovre, Denmark.

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Corresponding Author: Patrocinio Ariza Vega, Rehabilitation and Traumatology Virgen de las Nieves University Hospital. Carretera de Jaén S/N, 18013, Granada. Spain. Telephone: 0034958021596 / 0034637205620 E-mail: pariza@ugr.es

Non weight-bearing status compromises the functional level up to 1-year after hip fracture surgery

ABSTRACT

Objective: To examine the influence of weight-bearing (WB) status after hip fracture surgery to the 1-year functional outcome.

Design: This was a prospective cohort study, carried out in a public acute hospital, trauma service. The 194 patients (36 men and 158 women) with a mean (SD) age of 81.4 (6.1) years were admitted with a hip fracture within 2009, and followed for one year thereafter. The influence of postoperative weight-bearing status on the 1-year functional outcome was assessed using the Functional Independence Measure (18-126 points), adjusting for other known factors by multiple lineal regression.

Results: Seventy-five patients (39%) were not allowed WB for a period of 2-4 weeks after surgery. Improved functional outcomes were associated positively with pre-fracture functional level ($p<0.001$), trochanteric fracture and weight bearing during the whole first year after fracture (<0.001). Age and cognitive impairment of the patient were associated negatively with the 1-year functional outcome ($p<0.001$). Low pre-fracture functional level and cognitive impairment were the main determinants of functional level, respectively $\beta=-24.1$ and -22.1 ($p<0.001$).

Conclusions: WB status after surgery, in addition to pre-fracture function, cognitive status, age and fracture type were found to be independent predictors of the 1-year functional outcome in hip fracture patients.

Key Words: Hip fractures; Weight-bearing; Rehabilitation; Function

The immediate optimized treatment of patients with hip fracture can influence the postoperative outcome, and the importance of early weight-bearing (WB) and mobilization have been evaluated in a number of studies.[1-4] It has been shown that patients voluntarily limit loading of the fractured limb within the first 3-4 months after hip fracture surgery, beyond "weight-bearing as tolerated" (WBAT).[5-6] However, the decision to allow early, full WB (practiced as WBAT) after hip fracture differs from one country to the next. In northern Europe, around 95% of patients are allowed WBAT after hip fracture surgery, with no surgical restrictions of WB, [7-8] while 77% were allowed WB in an Australian study.[3] In a recent North American study, 79% of a group of hip fracture patients treated with arthroplasty were allowed WBAT.[4] The follow-up of patients admitted to skilled nursing and inpatient facilities showed a 2.6 greater likelihood of home discharge when allowed WBAT as compared to restricted WB.[4]

The rationale for restricted WB following hip fracture surgery reflects concerns about the stability of the fracture and the belief that surgical complications are reduced with less WB. At the same time, low revision rates are seen after unrestricted WB in patients with a primary fixation of intertrochanteric (2.9% revisions) and femoral neck fractures (5.3% revisions).[9] Still, the prescription of WB status after hip fracture "remains controversial",[7,10] as restricted WB could delay or reduce one´s functional recovery and return to independent living.

At the hospital of study, in southern Spain, we observed a remarkably large number of patients with NWB status, which was considered of potential importance for their functional outcome. Because such observations should be confirmed through systematic data collection in addition to follow-up regarding the functional outcome, the objective of our study was to examine the influence of WB status after hip fracture surgery in view of the 3-month and 1-year functional outcome.

METHODS

Study Patients

We carried out a prospective cohort study of patients with an acute hip fracture admitted at a traumatology service in southern Spain, between January 2009 and January 2010. The hospital covers a population of around 350,000 inhabitants. Patients included met the following criteria: 1) Age 65 or older; 2) Informed consent to participate in the study; 3) Absence of terminal disease. For patients with cognitive impairment, the closest relative or caregiver signed the informed consent. The ethics committee of the hospital approved the study.

A total of 275 consecutive patients with hip fracture were available for the study, but 17 had multiple fractures, 18 were readmitted due to surgical complications, 43 died, and three withdrew from the study before the 1-year follow up, leaving 194 patients in the final analysis.

Procedure

Clinical data regarding the risk of surgery/health status, taken from the patient's medical record, were assessed by means of the American Society of Anaesthesiologists (ASA),[11] accounting for length of hospital stay, type of surgery, time to surgery, WB status, and using wheelchair or walking aids at discharge. Type of fracture was classified as cervical or trochanteric according to the OTA classification; Cervical as (31-B1-B2-B3) and trochanteric as (31-A1-A2-A3)[12].

The WB status of all patients was decided by orthopedic surgeons at the hospital as either 1) allowed full WB (practiced as WBAT) 48 hours after surgery, or 2) not allowed any WB for the first two to four weeks after surgery.

Socio-demographic data regarding weight and height (body mass index), prefracture residence, place of the fall, cognitive status (measured by the Pfeiffer scale),[13] personal aid at discharge and discharge

destination, were recorded during an in-hospital post-surgery interview with the patient and relatives or caregiver.

Furthermore, functional level a week before the hip fracture, using the Functional Independence Measure (FIM),[14] was recorded during this structured face-to-face interview based on a questionnaire. It was followed by an interview 3 months after surgery, likewise conducted at the hospital coinciding with a scheduled Traumatology visit, and a 1-year survey done by telephone. All information was collected and managed by one experienced therapist-interviewer. The medical records were usually reviewed on the same day as the interview.

Rehabilitation

During their in-hospital rehabilitation, all patients who are allowed WB begin early assisted ambulation on weekdays, while NWB patients receive a few sessions of upper body endurance exercises and stretching. Patients allowed WB are normally referred for physiotherapy in outpatient rehabilitation facilities in the community or in their own home. In contrast, NWB patients do not receive rehabilitation before being allowed WB, when discharged to their own home. Outpatient physiotherapy treatment includes strengthening, balance and stair-climbing exercises, normally in 10-15 sessions within two to three weeks after discharge. Regardless of WB status, all patients who are discharged to a nursing home would receive physiotherapy and occupational therapy during weekdays for some months.

The Functional Independence Measure

The FIM, our main outcome variable, is grouped into six categories with a total of 18 items, 13 corresponding to physical and five to cognitive domains.[14] Items are scored on an ordinal scale ranging from 1 to 7, where 1 is "totally assisted" and 7 is "completely independent". Total score ranges from 18 (lowest) to 126 (fully independent). Based on the FIM total score, we constructed a new variable to categorize the level of independence as either *need for some type of personal*

assistance for FIM values from 18 to 90 (assuming a score of 5 or below for each item of the scale) or *independent,* when FIM values were between 91 and 126 (a score of six or seven for each item). The FIM is well validated for patients during hip fracture rehabilitation.[14]

Statistical analysis

Categorical data are presented as numbers with percentage, and continuous data as means ± SD, if normally distributed. We used the Student *t*-test for continuous normally distributed data; the Mann-Whitney U test was applied for continuous non-normally distributed data and the Chi-square or Fischer's exact test for categorical variables. Simple and multiple linear regressions were used to examine the influence of WB status in addition to other predictor variables upon the functional level at 3 months and 1 year after hip fracture surgery, to establish unadjusted (crude) and adjusted Beta-values.

Reference categories used in multiple linear regression analyses were: female gender, prefracture functional level (high), cognitive status (no cognitive impairment), high health status (ASA rating 1-2), prefracture residence (own home), rehabilitation after discharge (no), cervical fracture, and WB (allowed), while age was entered as a continuous variable.

The SPSS version 15.0 was used to perform all statistical analyses, and the level of significance was set at $P < .05$.

RESULTS

The patients followed were 158 women (81%) and 36 men with a mean age of 81.4 (6.1); altogether, 119 (61%) were allowed WB at 48 hours after surgery (Table 1). The type of surgery for the 75 patients not allowed WB was: Dynamic Hip Screw with plate (57%), Intra Medullar Hip Screw (29%) and Hemiarthroplasty (14%). Distribution of other baseline characteristics and outcome of the 119

WB and 75 NWB patients is shown in Table 1. As seen, there were no significant differences between patients allowed WB and those who were not for important variables such as age, prefracture functional level, cognitive and health status (Table 1). However, patients who were not allowed WB more often had (P<.04) a trochanteric fracture, surgery with an intra medullar hip screw or dynamic hip screw with plate, fewer rehabilitation sessions during their hospital stay; and they were residents in a nursing home when the fracture occurred, more likely to be discharged to a nursing home from the hospital, needed a wheelchair at discharge and had more falls indoors (Table 1).

Unadjusted regression analysis showed that age, prefracture functional level, cognitive status, health status and residential status, in addition to WB status, significantly influenced the 3-month and 1-year functional outcome (P < .03), whereas gender, rehabilitation after hospital discharge and fracture type did not (P > .05, Tables 2 and 3).

Multiple linear regression analysis revealed age, prefracture functional level, cognitive status, fracture type and WB status (P<.02) to be independent predictors of the 3-month functional outcome, when adjusted for gender, rehabilitation and residential status (Table 2). The regression model was statistically stable, and explained 68% of the variation in the 3-month functional outcome. Similar results were seen when multiple linear regression analysis was performed for the 1-year functional outcome with the additional consideration that health status could be an independent predictor of the 1-year functional outcome (Table 3).

DISCUSSION

To our knowledge, this is the first study evaluating the long-term influence of WB status in terms of the functional outcome of patients having surgery after a cervical or trochanteric hip fracture. Another novel aspect is that the long-term follow-up consecutively includes patients regardless of their sex, cognitive health or residential status. We found that 39% of patients had two to four weeks of NWB

status following surgery, and this was associated with a significant decrease in their functional level up to 1-year after surgery.

Weight-Bearing

The patients who were not allowed WB were found to have a FIM total score that was lower at 3-months and 1-year post-surgery as compared to those with no restrictions. Interestingly however, a higher proportion of NWB patients, as opposed to WB patients, had undergone outpatient rehabilitation sessions within three months after surgery. Authors Siebens et al.[4] found no difference in the functional outcomes assessed with the FIM at rehabilitation discharge, and Wu et al.[3] found no difference in mobility status upon discharge and return to pre-fracture living status when comparing patients allowed WBAT and those with restricted WB. Yet comparison of these two studies and the present contribution is not possible, as the study by Siebens et al.[4] included "only" selected patients with arthroplasty and had a low follow-up rate (84 out of 224 patients), while patients with restricted WB in the study by Wu et al.[3] stayed significantly more days in hospital for rehabilitation. Moreover, both studies used a definition of WB that included only 2% [4] and 8% [3] of patients with a NWB status out of respectively 21% and 23% with restricted WB. That is, their "restricted" patients were actually allowed some level of WB.

The proportion of NWB patients in the present study is higher than that of studies published within the last three years (less than 24% with WB restrictions),[3,4] and much higher than reports from Northern Europe (2% with WB restrictions).[8] The latter reflects recommendations of unrestricted WB after hip fracture surgery,[5] over 15 years ago. We should also stress that the present study included patients with cognitive impairment and those not living in their own homes, unlike the study by Koval et al. At any rate, this does not justify the large proportion of NWB patients in our context. Evaluation of the criteria underlying the recommendation of NWB is clearly needed, especially since patients allowed WBAT apparently limit loading of the fractured limb within the months following hip fracture surgery.[5,6]

Length of stay

Patients with NWB stayed fewer days in the acute section of the study hospital as compared to patients allowed WB. In a previous study, patients with restricted WB stayed longer in hospital for rehabilitation than those with WBAT.[3] This apparent discrepancy may depend upon the discharge criteria of different settings and health care systems. In some countries, patients are mainly discharged to and cared for by their relatives, not by the health care system, and are discharged when they are medically stable. Thus, our NWB patients were discharged sooner than patients allowed WB, and hence started rehabilitation in an outpatient rehabilitation facility when they were ready to bear weight on the fractured limb.

The two to four weeks of immobilization (95% of patients using wheelchairs discharged from hospital were NWB) might explain the long-term loss of function in the NWB patients of the present study. Indeed, injury and even a short period of immobilization accelerate the loss of lean muscle mass in elderly people, and a high percentage probably showed signs of sarcopenia (age-related loss of lean tissue mass), implying a loss of strength and function.[15]

Baseline characteristics

We found no significant difference between WB and NWB patients in variables such as age, gender, health status, cognitive status, and prefracture functional level. Similar findings are reported by Wu et al.[3] and Siebens et al.[4] However, a study with a different focus (all patients allowed immediate WB) showed that surgery on a preholiday was associated with retarded WB (the ability to stand for 2 minutes within 48 hours).[2]

Our study, in line with many previous ones, established age,[3,7,16-22] cognitive status[15,17,19-20,22-24] and pre-fracture functional level [19,21-22,25] as independent factors influencing the long-term functional outcome of patients with hip fracture. This strengthens the validity of NWB status as an influence on

the patient´s long-term outcome, when analyzed together with these strong predictors as in the present study.

Fracture Type

Patients with a trochanteric fracture had mean FIM scores that were higher at 3-months and 1-year than the scores of patients with cervical fractures in this study. In contrast, Haentjens et al.[26] found that the functional outcome among women was better for those with a cervical fracture as opposed to an intertrochanteric one at hospital discharge, with no fracture-type differences one year later. A study by Adunsky et al.[1] did not detect any association between functional recovery and type of fracture in women without cognitive impairment during the rehabilitation period. Most reports [1,7,27] look at the fracture-type influence on short-term outcome, for which reason the long-term outcome, addressed by the present study, is still a matter of great uncertainty.

Study Limitations

The methodological strengths of our study include its prospective design with consecutively admitted patients, the long-term (one year) follow-up period, the inclusion of all types of hip fracture surgery and the use of the FIM, a well-validated instrument to measure functional outcome. Yet our study is not free of limitations. Although hospital protocol establishes that all patients should receive a similar number of rehabilitation sessions, reality is far different, mainly due to hospital bureaucracy. Also, there are considerations that may interfere with patients´ receiving rehabilitation after hospital discharge, e.g. their residential status and decisions made by surgeons. The fact of the matter is that only a few in-hospital sessions were given to the patients included in our cohort, while 70% of WB patients and 30% of NWB patients received no sessions at all after their hospital discharge. Furthermore, the type of rehabilitation and the time period of duration were not standardized.

Conclusions

The weight-bearing status of an elderly patient after surgery for hip fracture, in addition to pre-fracture function, cognitive status, age and fracture type, can be considered as independent predictors of both their 3-month and 1-year functional outcome. Orthopaedic surgeons might evaluate whether more patients could benefit from WB immediately after surgery.

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Table1. Characteristics and Outcome Measures of Patients According to Weight-Bearing Status.

Characteristics	Total N=194(%)	WB N=119(%)	NWB N=75(%)	*P*
Age in years, mean (SD)	81.4(6.1)	81.2 (6.0)	81.6 (6.3)	0.7
Women	158 (81)	94 (79)	64 (85)	0.3
Men	36 (19)	25 (21)	11 (15)	
Prefracture functional level previous (FIM 18-90)	48 (25)	25 (21)	23 (31)	0.1
Prefracture functional level previous (FIM 91-126)	146 (75)	94 (79)	52 (69)	
Body mass index: ≤ 25 *	72 (38)	49 (42)	23 (31)	0.1
Body mass index: > 25 *	120 (62)	69 (58)	51 (69)	
ASA (1-2)	78 (40)	47 (39)	31 (41)	0.8
ASA (3-5)	116 (60)	72 (61)	44 (59)	
No or light cognitive impairment (Pfeiffer 0-4)	130 (67)	82 (69)	48 (64)	0.5
Severe cognitive impairment (Pfeiffer 5-10)	64 (33)	37 (31)	27 (36)	
Length of hospital stay in days, mean (SD)	13.1(9.7)	13.7 (10.8)	12.2 (7.6)	0.3
Cervical fracture	91 (47)	69 (58)	22 (29)	<0.001
Trochanteric fracture	103 (53)	50 (42)	53 (71)	
Rehabilitation sessions in-hospital, number, mean (SD)	4.5 (4.3)	5.0 (5.0)	3.6 (2.7)	0.022
Outpatient rehabilitation within 3-months: yes*	130 (67)	74 (63)	56 (75)	0.08
Outpatient rehabilitation within 3-months: no*	63 (33)	44 (37)	19 (25)	
Surgery: Dynamic Hip Screw with plate	96 (50)	53 (45)	43 (57)	<0.001
Surgery: Intra Medullar Hip Screw	33 (17)	11 (9)	22 (30)	
Surgery: Hemiarthroplasty	65 (33)	55 (46)	10 (13)	
Prefracture residence: Own home	128 (66)	84 (71)	44 (59)	0.034
Prefracture residence: Relative´s home	42 (22)	26 (22)	16 (21)	
Prefracture residence: Nursing home	24 (12)	9 (7)	15 (20)	
Discharge destination: Own home	106 (54)	70 (59)	36 (48)	0.008
Discharge destination: Relative´s home	50 (26)	34 (29)	16 (21)	
Discharge destination: Nursing home	38 (20)	15 (12)	23 (31)	
Assistance at discharge: Formal caregiver	55 (28)	29 (24)	26 (35)	0.1
Assistance at discharge: Informal caregiver, family	139 (72)	90 (76)	49 (65)	
Aid at discharge: Wheelchair	62 (32)	3 (3)	59 (79)	<0.001
Aid at discharge: Walker or crutches	132 (68)	116 (97)	16 (21)	
Indoor fall*	158 (82)	91 (76)	67 (91)	0.034
Outdoor fall*	35 (18)	28 (24)	7 (9)	

SD, standard deviation. *Total number less than 194 due to missing data.

Table 2. Simple and Multiple Linear Regression Analysis of the 3-month Functional Independence Measure Score (18-126 points) after Hip Fracture Surgery, n=193

Factors	Crude β-values (95%CI)	*P*	Adjusted β-values (95%CI)	*P*
Age (continuous)	-2.2 (-2.8 − -1.6)	<0.001	-1.1 (-1.5 − -0.6)	<0.001
Men	-8.1 (-19.0 − 2.8)	0.1	3.5 (-3.2 − 10.2)	0.3
Low prefracture functional level	-41.1 (-52.6 − -37.6)	<0.001	-23.8 (-30.8 − -16.8)	<0.001
Severe cognitive impairment	-41.0 (-47.9 − -34.0)	<0.001	-22.7 (-29.1 − -16.4)	<0.001
Rehabilitation session 3 months (yes)	6.8 (-2.3 − 15.9)	0.1	2.7 (-3.1 − 8.4)	0.1
Within own home pre-fracture (reference)				
Relative´s home pre-fracture	-15.1 (-25.2 − -4.9)	0.004	-4.6 (-11.2 − 1.9)	0.2
Nursing home pre-fracture	-26.3 (-38.7 − -13.9)	<0.001	-7.2 (-16.0 − 1.6)	0.1
Low health status (ASA 3-5)	-13.8 (-22.2 − -5.3)	0.002	-4.6 (-9.9 − 0.6)	0.09
Trochanteric fracture	6.3 (-2.2 − - 14.8)	0.1	6.5 (1.2 − 11.8)	0.02
Non weight-bearing	-16.5 (-25.0 − -8.1)	<0.001	-14.1 (-19.6 − -8.7)	<0.001

CI, confidence interval; FIM, Functional Independence Measure; ASA, American Society of Anaesthesiologists rating

Low prefracture functional level (FIM score 18-90); Severe cognitive impairment (Pfeiffer score 5-10)

Table 3. Simple and Multiple Linear Regression Analysis of the 1-year Functional Independence Measure Score (18-126 points) after Hip Fracture Surgery, n=193

Factors	**Crude β-values (95%CI)**	***P***	**Adjusted β-values (95%CI)**	***P***
Age (continuous)	-2.1 (-2.8 − -1.5)	<0.001	-1.1 (-1.6 − -0.6)	<0.001
Male sex	-7.8 (-19.3 − - 3.7)	0.2	-3.5 (-11.2 − 4.3)	0.4
Low prefracture functional level	-44.7 (-52.9 − -36.5)	<0.001	-24.1 (-32.2 − -15.9)	<0.001
Severe cognitive impairment	-40.5 (-48.1 − -32.9)	<0.001	-22.1 (-29.5 − -14.6)	<0.001
Rehabilitation sessions within 3 months (yes)	6.4 (-3.2 − 16.0)	0.2	1.7 (-5.0 − 8.4)	0.6
Within own home previous (reference)				
Relative´s home previous	-12.1 (-22.8 − -1.3)	0.028	-1.5 (-9.1 − 6.1)	0.7
Nursing home previous	-26.2 (-39.3 − -13.1)	<0.001	-6.2 (-16.3 − 4.0)	0.2
Low health status (ASA 3-5)	-14.8 (-23.7 − -5.9)	0.001	-6.1 (-12.2 − -0.1)	0.052
Trochanteric fracture	8.8 (-0.1 − 17.7)	0.052	9.3 (3.1 − 15.5)	0.004
Non weight-bearing	-16.2 (-25.1 − -7.3)	<0.001	-14.6 (-21.0 − -8.3)	<0.001

CI, confidence interval; FIM, Functional Independence Measure; ASA, American Society of Anaesthesiologists rating

Low prefracture functional level (FIM score 18-90); Severe cognitive impairment (Pfeiffer score 5-10)

Predictors of long term mortality in elderly hip fracture patients

III

Predictors of long term mortality in elderly hip fracture patients.

Patrocinio Ariza-Vega,[1,2] Jose Juan Jiménez-Moleón,[3,4] Morten Tange Kristensen[5]

[1]Rehabilitation and Traumatology Service, Virgen de las Nieves Hospital, Granada.

[2]Department of Physiotherapy, University of Granada, Spain.

[3]Department of Preventive Medicine and Public Health. University of Granada.

[4]CIBER Epidemiología y Salud Pública (CIBERESP), Spain

[5]Department of Physiotherapy and Orthopaedic Surgery, Hvidovre University Hospital, Copenhagen, Denmark

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Corresponding Author: Patrocinio Ariza Vega, Rehabilitation and Traumatologic Virgen de las Nieves University Hospital. Carretera de Jaén S/N, 18013, Granada. Spain. Telephone: 0034958021596 / 0034637205620 E-mail: pariza@ugr.es

Running head: Mortality after hip fracture

Predictors of long term mortality in elderly hip fracture patients.

INTRODUCTION

The incidence of hip fractures and their outcomes are expected to rise with the growing elderly population without changes to the prevention and treatment of this pathology (1). Hip fractures can be considered one of the most important public health burdens between elderly people due to its high incidence and its outcome (1-3). The main consequences of a hip fracture are an increased likelihood of morbidity, disability and mortality (4-5).

The increased risk of death after hip fracture has been amply shown in the literature (6-8), with 1 year mortality ranging from 8.4% to 36% with geographical variations (7,9). Currently, it is not known if the differences between countries, related with the likehood of death, are due to the variations in the demographics of patients, or due to the diversities in treatment methods (10).

Several researches have studied mortality after hip fracture but there are often weaknesses in some of these studies, such as a short follow-up period studying mainly in-hospital mortality (2,3,11-12) and 30 days mortality after hip fracture (13), a retrospective design (4,14), or the adjusted analysis of a reduced number of predisposing factors (15) mainly related with comorbidities.

If we focus on the reports that studied factors associated with the increase of one-year mortality, they showed that the influence of some of these factors continue being not

clear (4,16-19). The advanced age (2-4,11,16,20-21), male gender (3,8,10,21-23), the presence of concomitant illness (2,4,11-12,24), poor health status (16), poor prefracture functional status (9,20) and dementia (4,9) have been reported by several studies. However, there are other factors such as the type of fracture (22,25) or the place of residence (16,26) that need to be studied more in depth. These reports show some controversies about the risk factors for high mortality, so further studies are required.

Knowledge of the risk factors for mortality in hip fracture patients is important because it can help to identify patients who have a higher risk of mortality, and aid in the design of new care models using the treatment methods that demonstrated being better to reduce the high mortality. The aims of this study were to determine one year mortality and predisposing factors in elderly patients with hip fracture.

METHOD

Participants

We performed a prospective cohort study of patients with an acute hip fracture admitted consecutively at a traumatology service in southern Spain, between January 2009 and January 2010. The hospital covers a population of around 350,000 inhabitants. The patients included met the selection criteria of being 65 years or older and accepting to participate in the study, signing an informed consent form. For patients with cognitive impairment, the closest relative or caregiver signed the informed consent. The ethics committee of the hospital approved the study.

A total of 281 patients with hip fracture fulfilled the inclusion criteria, of which six died within 24 hours after surgery (information about socio-demographic or clinical data of these patients were not recorded), leaving 275 patients for final analysis.

Measures and follow-up

The data were collected from the medical record and the interviews with the patients and their relatives. Clinical data, regarding the surgery risk/health status before surgery, comorbidity, type of fracture (intracapsular or extracapsular), medical or surgical complications after surgery, time from admission to surgery and length of hospital stay were taken from the medical record. Socio-demographic data, weight and height (body mass index) at the moment of the fracture, the cognitive status, the prefracture functional level and the residential status (recoded in three categories: 1) Continue living in their own or with relatives, 2) continue living in a nursing home, 3) change of residence after the hip fracture), were recorded during an interview with the patient, their relatives or their caregiver.

The first interview took place during the hospital stay after surgery with the patient, their relatives or their caregiver. The same interviewer did the last interview by phone at the end of one year after surgery. The medical records were usually reviewed the same day as the interview.

The mortality was calculated subtracting the data of the death (it was obtained from the interview with the relatives and from the medical records) and the data of the surgery. The cognitive status was assessed by the Pffeifer Scale (27), and it was categorized as light or not cognitive impairment [0-4] and severe cognitive impairment [5-10]. The

prefracture functional level was measured by the Functional Independence Measure (FIM) (28,29). It has six categories with a total of eighteen items. Each item is scored from 1 to 7 based on the level of independence, where 1 represents total dependence and 7 indicates complete independence. We did a dichotomisation of the FIM score into an independent level (18-90, including scores of 6 or 7 for each item) and a need for some kind of personal assistance (91-126, including scores between 1 and 5 for each item) The FIM has been well validated for patients during hip fracture rehabilitation. Surgery risk/health status was assessed using the American Society of Anaesthesiologists (ASA) (30) which was categorized as high health status (1-2) and low health status (3-5). The Charlson index (31) was used to measure the comorbidity. The medical or surgical complications were categorized in one dichotomic variable if a patient had one of the following complications: nosocomial infection, pressure ulcer, delirium or resurgery.

Statistical analysis

Absolute and relative frequencies for categorical variables and mean with standard desviation for quantitative variables were calculated. For non-normally distributed data median and percentiles 25-75 were used. To compare proportion, Chi-square test and exact Fisher test were employed when appropriate. T student was used for comparing normal distributed variables among live and death and for non-normal we employed the Mann-Whitney test.

The outcome studied was the time to death after surgery for hip fracture. We used survival analysis techniques such as Kaplan-Meier chart to calculate cumulative survival probability up to one year from surgery. Log rank test was used to evaluate

differences among Kaplan-Meier chart. Cox regression models at one year were performed to analyse the associated factors to mortality. The selection of co-variables was done using statistical and epidemiological criteria. The factors evaluated were: age (years), sex (female vs male), cognitive status (Pffeifer score 0-4 vs >4), Prefracture functional level (High score 91-126 vs Low score18-90), Comorbidity (Charlson Index score), type of fracture (intracapsular vs extracapsular), allowed Weightbearing (yes vs no), Residence status (continue living with relatives and own home vs continue living in a nursing home vs change of residence after hip fracture). Adjusted Hazard ratios (HZ) and 95% confidence intervals (CIs) were calculated.

All analyses were done using SPSS version 15.0 and the level of significance was set at $p>0.05$.

RESULTS

The mean age of the 275 survivors after 24 hours from surgery was 81.4 (6.8) years, 216 (79%) of whom were women. Most of these patients, 201 (73%), had a high functional level prefracture, and 174 (63%) had no cognitive impairment. The rest of the baseline demographic and clinical data are shown in table 1.

The mortality of the operated hip fracture within the one year following period was 21% (16.1-25.9%). The respective number for mortality at one month was 5% (2.5-8.1%), at three months was 10% (6.6-14.1%) and at six months was 16% (11.2-20.1%). (Figure 1)

The one year mortality was higher in men (29% vs 17% women p=0.036), those who had a low prefracture functional level (32 vs 14% p=0.001), had prefracture cognitive

impairment (33 vs 11% p<0.001), were not allowed weight-bearing after surgery (26 vs 14% p=0.013), had more medical and surgical complications (26 vs 14% p=0.015), changed the place of residence (33% vs 28% continue living in a nursing home and vs 16% continue living with relatives or their own home, p=0.051), had a higher Charlson score (median of 7(6-8) vs 6 (5-7) p<0.001), and their stays at the hospital were longer (median of 15 (8.5-21) vs 11 (7-16) p= 0.005). The rest of the variables presented in table I do not show significant statistical differences between patients that did or did not survive longer than one year. (Table 1)

Kaplan-Meier survival chart for residence status is shown in figure 2. During the one year follow-up period, the probability of surviving a hip fracture was significantly lower in those who changed their residence place (84% living at their own place or with relatives, 72% living in a nursing home, 67% changing the place of residence p= 0.029) Figure 2.

In the unadjusted analysis the higher risk of mortality was found on men (1.83 95% CI 1.03-3.25), who had cognitive impairment (3.25 95% CI 1.86-5.66) and a low prefracture functional level (2.43 95% CI 1.42-4.18).

In the adjusted analysis, the variables associated with mortality one year after surgery were the following: men sex (HR 2.86 95% CI 1.55-5.31), change of residence place (HR 2.78 95% CI 1.25-6.19), cognitive impairment (HR 2.20 95% CI 1.14-4.26) and Charlson index score (HR 1.24 95% CI 1.08-1.41). (Table 2)

DISCUSSION

The current studied showed that the mortality one year after surgery was 21% of the patients. The risk of mortality was higher during the first six months and then declines thereafter. This is consistent with other reports and reviews that showed ranking of mortality from 22-30% at one year (1,4,10,24).

Our results prove that age, men sex, prior cognitive impairment, low prefracture functional level, higher Charlson score, not allowed weight-bearing after surgery and change of residence due to the hip fracture are significant predictors of mortality at one year. These data confirm part of the main results of other reports (4,16,20,21,24). However, these studies did not consider the variables of change of residence and being "not allowed weight bearing" ,which is an independent predictor of mortality at one year in our results.

The influence of early weight bearing and mobilization on the postoperative functional outcome after a hip fracture has been evaluated in a number of studies (32-33). However, there is a lack of knowledge of the influence of weight bearing on mortality after hip fracture. Some reports (15) have studied some complications, such as a decubitus ulcer or respiratory disease, as risk factors or mortality, but some of those complications could be due to late weight bearing and mobilization.

The change of residence after a hip fracture (from own home to a nursing home) is a risk factor of mortality in our population. These results are consistent with the results of a British study (16) which showed that patients admitted from home who were able to

return there had a median survival of 5.25 years while those who need new placement in institutional care had a median survival of 1.33 years. An Australian report (26) showed that the overall hazard ratio for death in nursing home patients one year after hip fracture was 1.8 (95% confidence interval of 1.4-2.4). However, the change of residence should be studied more in depth because most of the reports studied the prefracture residence as a risk factor but they do not include the change of residence in adjusted analyses. The residential status and the social support differ between countries. In Spain, patients who changed their place of residence were those who usually had a low health status (most of them were looked after by their relatives before the fracture) and the hip fracture aggravate their poor health status (they went to live to a nursing home after the hip fracture)

The adjusted analysis showed men sex, prior cognitive impairment, higher Charlson index and change of residence as significant predictors of mortality at one year. These results are consistent with other studies that found men sex(1,4,16,20,34-35), prior cognitive impairment (1,20,35), the higher Charlson Index or the presence of comorbid conditions (4,12,24) as significant predictors of long term mortality too.

The main difference of our results and the results found in the literature is related with the age. The age was found a predictor of mortality in several studies (4,11,16,20-21). However, in our study the age was a predictor in the unadjusted analyses but it was not a significant predictor of one year-mortality when was adjusted by the rest of the variables. This is consistent with the results of a study (36) carried out in an orthogeriatric unit in Norway, where the age was not a predictor of mortality when was adjusted by gender, prefracture residence, type of fracture, time to surgery, number of

comorbidities, health status, complications after surgery, and type of complications (36). An Australian report (37) found that the age effects over the risk of death were significant only during the first three months after surgery. These results suggest that the mortality due to hip fracture could be explained by other factors more important than the age and more studies should be required to find those factors.

The high risk of death after a hip fracture mainly for men, with cognitive impairment, with some illness associated have been reported in all the studies. More efforts should be carried out to prevent this pathology and evaluate changes in the postoperative care in this population, in order to reduce the high likelihood of mortality. On the other hand, the absence of knowledge about the impact of each factor and the conflicting showed in the literature about some of those factors associated with mortality, shows the need for further detailed studies.

Limitation

Our study has some limitations that need to be highlighted. Patients who did not have surgery due to medical decision and those who died before surgery were not included in the study. Data of patients who died 24 hours after surgery were not recorded since the relatives were not available to sign the informed consent, so they were only included to calculate the total mortality. The methodological strengths of our study include its prospective design and the long-term (one-year) follow-up period. In addition, it is the first study about long-term mortality and factors associated in this part of the country and we had a very low rate of missing data, so our sample is very representative of the population of the region.

Conclusions

One year mortality after surgery in older patients with hip fractures is about 21% in southern Spain. Men sex, prior cognitive impairment, high Charlson index score and change of residence were negatively associated with long term mortality when adjusted by age, prefracture functional level, type of fracture and allowed weight-bearing.

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Table 1. Table sociodemographic and clinical data

	Total N=275	Alive n=222	Exitus n=53	
	N (%)	N (%)	N (%)	P-value
Mean Age (SD)	81.4 (6.8)	80.9 (6.4)	83.7 (7.8)	0.15
Women	216 (79)	180 (83)	36 (17)	0.036
Men	59 (21)	42 (71)	17 (29)	
Low Prefracture functional level	74 (27)	50 (68)	24 (32)	0.001
High Prefracture functional level	201 (73)	172 (86)	29 (14)	
Normalweight*	108 (40)	84 (78)	24 (22)	0.4
Overweight*	111 (40)	89 (80)	22 (20)	
Obese*	54 (20)	47 (87)	7 (13)	
Hight Health Status (ASA)*	99 (36)	91 (92)	8 (8)	<0.001
Low Health Status (ASA)*	173 (64)	129 (75)	44 (25)	
Charlson Index*	6 (5-7)	6 (5-7)	7 (6-8)	<0.001
Whithout Cognitive impairment (Pfeiffer)	174 (63)	154 (89)	20 (11)	<0.001
Cognitive impairment (Pfeiffer)	101 (37)	68 (67)	33 (33)	
Surgery within 24 hours	134 (49)	114 (85)	20 (15)	0.08
Surgery after 24 hours	141 (51)	108 (77)	33 (23)	
Median Length of Hospital Stay (25-75%)	11 (7-18)	11 (7-16)	15 (8.5-21)	0.005
Intracapsular fracture*	129 (47)	107 (83)	22 (17)	0.4
Extracapsular fracture*	143 (53)	113 (79)	30 (21)	
Allowed Weight-bearing	161 (59)	138 (86)	23 (14)	0.013
Non allowed Weight-bearing	114 (41)	84 (74)	30 (26)	
Non Medical or surgical Complications	155 (56)	133 (86)	22 (14)	0.015
Medical or surgical Complications	120 (44)	89 (74)	31 (26)	
Relatives and Own home before and after	215 (78)	180 (84)	35 (16)	0.051
Nursing home before and after	36 (13)	26 (72)	10 (28)	
Change of residence after hip fracture	24 (9)	16 (67)	8 (33)	

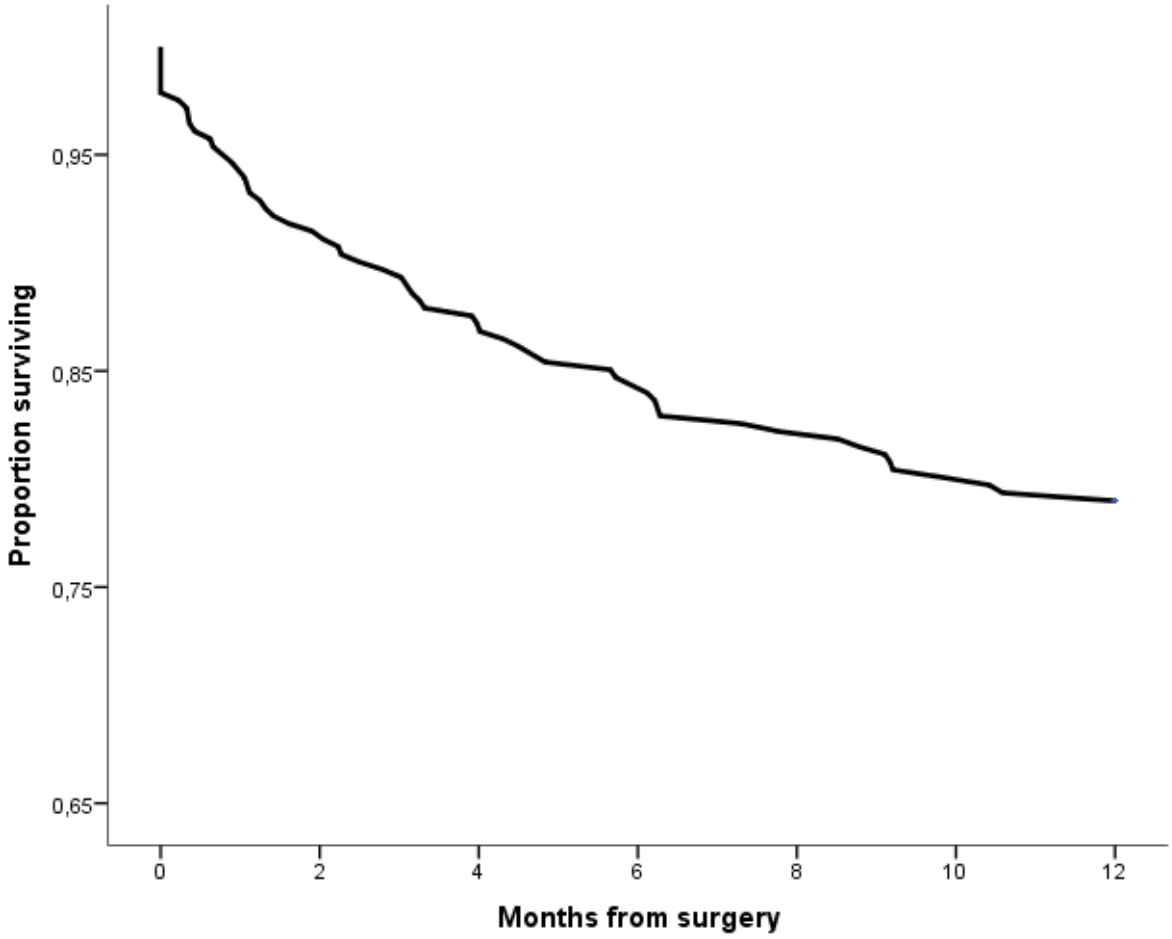
Note: *N = 272 due to missing data.

Table 2. Risk factors of mortality in the period of one year after surgery. Cox regression Model.

Risk Factors	Unadjusted HR (95% CI)	P-Value	Adjusted HR (95% CI)	P-Value
Age (per year of increase)	1.07 (1.02 - 1.12)	0.003	1.03 (0.98 - 1.08)	0.2
Men	1.83 (1.03 - 3.25)	0.041	2.86 (1.55 - 5.31)	0.001
Cognitive impairment	3.25 (1.86 - 5.66)	<0.001	2.2 (1.14 - 4.26)	0.019
Low prefracture functional level	2.43 (1.42 - 4.18)	0.001	1.36 (0.7 - 2.63)	0.4
Charlson index (per score of increase)	1.25 (1.12 - 1.4)	<0.001	1.24 (1.08 - 1.41)	0.002
Extracapsular fracture	1.25 (0.72 - 2.17)	0.4	1.23 (0.68 - 2.23)	0.5
Not Allowed Weightbearing	1.99 (1.16 - 3.43)	0.013	1.76 (0.96 - 3.22)	0.07
Continue living with relatives or own home (reference)				
Continue living in a nursing home	1.92 (0.95 - 3.88)	0.07	0.86 (0.4 - 1.83)	0.7
Change of the residence´s place	2.27 (1.05 - 4.88)	0.037	2.78 (1.25 - 6.19)	0.012

Note: HR= Hazard Ratio; CI= Confidence Interval

Figure 1. One year Kaplan-Meier estimates of the cumulative probability of survival after surgery.



The curve is truncated. Start score Y axis = 0.65

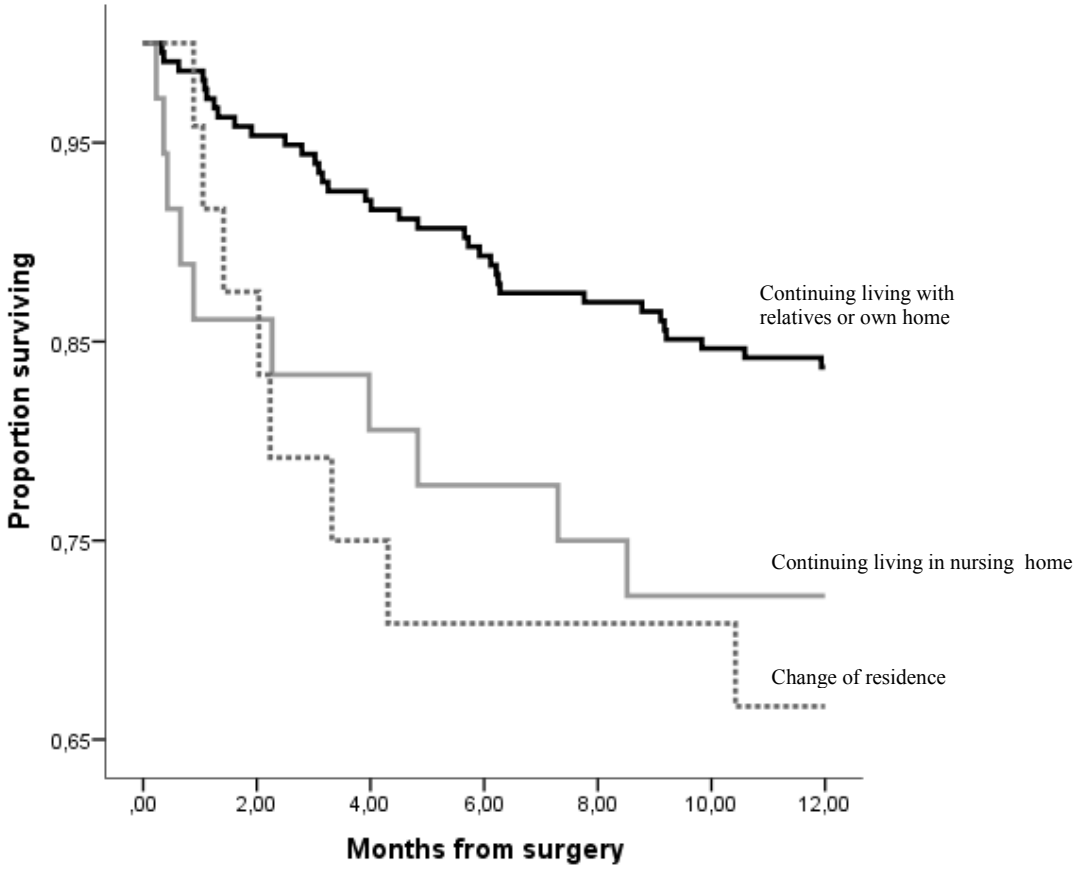


Figure 2: Kaplan-Meier survival charts for place of residence