Article type: Original Paper

-Full Title of de article:

Independent predictors of functional loss and refractures in patients with femur fracture: follow-up at 6 and 18 months in a Fracture Liaison Service

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Abstract

Background: In elderly patients hospitalized for a femur fracture, this study aimed to evaluate the functional evolution, and to estimate the incidence of second fractures at 6 and 18 months after hospital discharge.

***Patients and Methods*:** A longitudinal prospective study was designed at an Orthogeriatric Unit after implementing a Fracture Liaison Service (FLS). The variables collected included the baseline demographic and clinical characteristics of the patients, and the outcome variables on discharge, at 6 and 18 months of follow-up. Logistic regressions models were applied to identify independent predictors of functional evolution.

***Results*:** 478 patients were admitted. Independent predictors of functional loss at follow-up were: institutionalisation, severe dependence either prior to and on discharge, delirium, protein malnutrition, prior acute myocardial infarction, GFR<30 ml/min/1.73m^2 and not receiving treatment for osteoporosis on discharge. Patients attending follow-up appointments presented improved compliance with osteoporosis treatment both at 6 and 18 months. A lower number of 2nd fractures were recorded at 18 months for patients who attended their appointments (4.8% vs 12.1%, p=0.01). At 6 and 18 months follow-up, a lower rate of readmission was recorded (7% vs 15.3%, p=0,006), (9.6% vs 25.6%, p<0,0001), respectively.

Conclusions:

The independent predictors of functional loss at 6 and 18 months were institutionalisation, severe dependence either prior to and on discharge, delirium, protein malnutrition, prior acute myocardial infarct, GFR<30 ml/min/1.73m^2 and not receiving treatment for osteoporosis on discharge. A lower incidence of refractures, a lower readmission rate and a better treatment compliance were observed in patients attending follow-up visits.

Keywords: femur fracture, frailty fracture,, functional loss prediction. Fracture Liaison Service, osteoporosis

Abstract

Objetivo:

Evaluar la evolución funcional y estimar la incidencia de segundas fracturas en pacientes ancianos hospitalizados por fractura de fémur a los 6 y 18 meses del alta hospitalaria.

***Pacientes y métodos*:**

Se diseñó un estudio longitudinal y prospectivo en una Unidad de Ortogeriatría tras la implementación de una Fracture Liaison Service (FLS). Las variables recogidas incluyeron características demográficas y clínicas así como variables al alta hospitalaria, a los 6 y 18 meses de seguimiento en la FLS. Se aplicaron modelos de regresión logística para identificar los predictores independientes de la evolución funcional.

Resultados:

Los factores predictores independientes de pérdida funcional en el seguimiento fueron: institucionalización, dependencia severa previa y al alta, delirium, desnutrición proteica, infarto agudo de miocardio previo, FG<30ml/min/1.73m^2 y no recibir tratamiento para la osteoporosis al alta. Los que acudieron a las citas de seguimiento presentaron mejor cumplimiento del tratamiento de la osteoporosis tanto a los 6 como a los 18 meses. Se registró un menor número de segundas fracturas a los 18 meses en los pacientes que acudieron a las visitas (4.8% vs 12.1%, p=0.01). A los 6 y 18 meses de seguimiento se registró una menor tasa de reingresos (7% vs 15.3%, p=0,006), (9.6% vs 25.6%, p<0,0001), respectivamente.

Conclusiones:

Los factores predictores de pérdida funcional a los 6 y 18 meses fueron la institucionalización, la dependencia severa previa y al alta, el delirium, la desnutrición proteica, el infarto agudo de miocardio previo, el FG<30ml/min/m2 y no recibir tratamiento de la osteoporosis al alta. Se observó una menor incidencia de refracturas, una menor tasa de reingresos y un mejor cumplimiento del tratamiento en los pacientes que acudieron a las visitas de seguimiento.

1. INTRODUCTION:

Over the last 30 years, hip fracture care has evolved towards models of shared responsibility between medical and surgical teams[1]. Medical care should be tackled with a multidisciplinary approach, aimed at improving functional recovery, reducing intrahospital morbimortality and promoting that patients may come back home in a cognitive and functional condition similar to previous baseline status[2,3]. The protocolling of clinical guidelines ensures that the patient receives standard care at the appropriate time[4].

Patients with fractured femurs have 86% more probability of experiencing a second fracture, suffering greater functional loss and a higher rate of mortality[5]. Due to this, and to the high cost of the medical and social care of these patients, it is important to develop mechanisms to help prevent any further fractures, which tend to occur in the first or second year after the initial fracture[6].

In 2011, the Working Group of the Committee of Scientific Advisors of the International Osteoporosis Foundation (IOF) published a global consensus on a model of coordination for the secondary prevention of osteoporosis in patients with fragility fractures, known as a Fracture Liaison Service (FLS) [7]. The idea was for health services to develop a working system in which the different specialities involved in the care of patients with fractures would be able to collaborate in detecting them, assessing them and guaranteeing the secondary prevention of osteoporosis[8,9,10]. In this way, the FLS model, adapted to the needs of the individual health service, has been shown to be the most effective form of intervention when seeking to prevent secondary fractures [11].

In elderly patients hospitalized for a femur fracture, in an acute care centre where a Fracture Liaison Service (FLS) had been implemented, this study aimed to evaluate the independent predictors of the functional evolution and to estimate the incidence of second fractures at 6 and 18 months after hospital discharge.

2. PATIENTS AND METHODS

2.1 Design of study

A longitudinal prospective study was designed to include patients discharged from an Orthogeriatric Service in 2017. Follow-up was carried out by the Internal Medicine team, from the time of admission to 18 months later, working with the Fracture Liaison Service, and concluded in June 2019.

2.1.1 Setting for the study

The study was carried in an Orthogeriatric Unit of a University Acute Care Hospital with 300 medical-surgical hospital beds in Barcelona, Spain.

2.1.2 Multidisciplinary Clinical Guidelines and Fracture Liaison Service

The development of the Multidisciplinary Clinical Guidelines in 2017 and the accreditation of the Fracture Liaison Service in February 2018 led to three different changes in the hospital healthcare activities. Firstly, the Guidelines facilitated the unification of the criteria in clinical practice, both during the process of admission and throughout the follow-up period while under the Fracture Liaison Service. Secondly, patients were provided with continuous care during admission, offered by the Internal Medicine team provided 24 hours a day on working days, weekends and public holidays. Thirdly, follow-up was planned at 6 and 18 months from the time of discharge with the Internal Medicine and Geriatric teams, at a specific outpatient clinic with specific criteria for the management of the prevention of secondary fractures and guaranteed coordination with the Primary Healthcare Services from the time of discharge.

2.2 Patients

Patients admitted during 2017 to the Orthogeriatric Unit of the Moisés Broggi University Hospital with femur fractures were included in the study. The following inclusion criteria were applied: patients with a fracture of the proximal, diaphyseal or distal femur over 75 years of age, younger patients with femur fractures who, due to their comorbidity, were considered eligible for admission to improve their care, patients with periprosthetic fractures who met age and/or comorbidity criteria, and patients with fragility acetabulum fractures who, due to medical reasons, had to be admitted to hospital. Patients with multiple fragility fractures were also admitted to the unit.

2.2.1 Study Variables

Baseline characteristics, process and outcome variables were collected for all the patients admitted to the Orthogeriatric Unit, as was also the case throughout the follow-up, performed by the Fracture Liaison Service at 6 and 18 months from the date of discharge. All the records were included prospectively from the time of admission, complemented by the discharge reports. To minimise the loss of data of those people who failed to attend follow-up at 6 and 18 months, patients who failed to come into the unit were contacted over the telephone. If they didn't answer, the Health Consortium IT System and Catalan Shared Clinical Record registry were queried.

Regarding the baseline characteristics of the patients, the following data was collected: age, gender, marital status, education, household and family status, place of residence and whether there were any architectural barriers in the household. Type of fracture, kind of implant, number of fractures on admission, fractures prior to admission, pre-fracture functional parameters as

per the Barthel Index (BI), prior comorbidities as per the Charlson Comorbidity Index, anaesthetic risk as per the ASA classification, nutritional evaluation (protein, albumin and MNA-mini nutrition assessment test on admission) and bloodwork.

The variables recorded in the process of hospital discharge and at 6 and 18 months with the Fracture Liaison Service include: average length of stay, stay > 15 days, rehab programme on discharge, functional parameters on discharge with the BI, surgical intervention <48h, causes of surgical delay, transfusions on admission, prior treatment for osteoporosis and osteoporosis treatment on discharge. On follow-up at 6 and 18 months: BI during appointment, instrumental skills with the Lawton Brody scale, ability to ambulate as per the Timed Get up and Go test, cognitive assessment as per the Pfeiffer SPMSQ, bloodwork parameters and functional loss (pre-fracture BI and BI at 6 and 18 months). The data from the BI was used to calculate functional loss (FL) at 6 and 18 months, taken as pre-fracture BI minus BI at 6 and 18 months, respectively. The efficacy threshold was taken as a functional loss of under 20 points on the BI.

Lastly, the following were taken as prognostic variables on discharge and at 6 and 18 months with the Fracture Liaison Service: medical complications on admission such as delirium (Confusion Assessment Method (CAM)), heart failure, exacerbated chronic obstructive pulmonary disease (COPD), bronchospasm, acute or aggravated chronic kidney failure, acute urinary retention and nosocomial infection, complication of surgical wounds, pressure ulcers (PU) on admission and discharge, destination on discharge and mortality during admission. On the follow-up visits at 6 and 18 months, changes of address, death, attendance records on follow-up, consumption of psychotropics, hospital readmission for any reason, falls and new fractures, were all identified. The following major osteoporotic fractures were considered as new fractures in the follow-up period: femur, pelvis, humerus, forearm and vertebrae. The level of compliance and changes in osteoporosis treatment were also assessed. A drug was considered

as an active treatment when the patient had at least 80% of the medication prescriptions dispensed in the pharmacy. [12]

2.3 Statistical analysis:

Statistical analysis was performed with the IBM SPSS Statistics software, version 26. Categorical variables were expressed as counts and percentages, whereas means and standard deviations, or medians, were obtained for the description of continuous variables. The normality of continuous variables was assessed by applying the Kolmogorov-Smirnov test. The Chi-square test was used when comparing categorical variables between two groups. Differences in quantitative variables between groups were assessed by means of Student's t-test, or Mann-Whitney test as a non-parametric alternative. Significance level was set at 0.05. Variables that reached statistical significance or were close to it ($p<0,1$) in the univariate analysis, were considered as candidates to enter a logistic regression model. Both automatic selection techniques (backward, forward and stepwise) and manual selection of variables were applied to obtain the best model. Two different logistic regression models were constructed, to predict, 6-month and 18-month functional loss, respectively.

3. RESULTS

In *Table.1* the baseline characteristics, process and outcome variables are described and published for the 478 patients admitted to the Orthogeriatric Unit [13]. The majority were women of advanced age, widows, who lived at home with their families and had a basic level of literacy and mild level of functional dependence prior to the fracture (BI $\geq$ 60 points). 33.8% presented a degree of malnutrition on admission. Delirium was the medical complication most frequently found on admission (32.5%). On discharge, over half the patients required admission to a

functional recovery unit. 70% received treatment to prevent secondary fractures on discharge. 32.4% of patients were operated on within 48 hours of admission and the most common cause for surgical delay was a lack of availability of operating theatres (40.3%).

Table 2 shows the follow-up data from the Fracture Liaison Service at 6 and 18 months. Most patients presented difficulties with instrumental activities throughout the follow-up period. Over 70% of patients preserved their level of mobility at both follow-ups. At the 18 month follow-up an improvement in nutritional levels and iron deposits was observed, as well as reduced use of neuroleptics and antidepressants, and a higher record of falls and fractures. Compliance with osteoporosis treatment was over 75% both at 6 and 18 months, while the main cause of a lack of adherence was a change of treatment by the Primary Healthcare Service.

Table 3 analyses the influence of attending follow-up appointments at the FLS. Patients that attended their appointments presented a higher level of compliance with their osteoporosis treatment at 6 months (85.4% vs 38.6%, $p<0.0001$) and at 18 months (89.9% vs 24.3%, $p<0,0001$). A lower rate of second fractures was recorded at 18 months for those patients who attended their appointments (4.8% vs 12.1%, p0.01). Lower rates of readmission for any reason were observed for the patients that attended their appointments, both at 6 months (7% vs 15.3%, $p=0,006$) and at 18 months (9.6% vs 25.6%, $p<0,0001$).

The most frequent reasons for readmission were medical pathologies (67%), whereas fracture-related causes (7%) were the most infrequent ones. Only 8.7% of patients were hospitalized at the time of the follow-up visit.

Table 4 shows a bivariate analysis of the factors related to functional loss at 6 and 18 months. Older patients, without a partner, who lived in a care home, with a history of acute myocardial infarction or dementia, higher prior levels of dependence, a poorer Pfeiffer SPMSQ score, a

positive CAM test and parameters of protein undernutrition, presented greater functional loss at 6 and 18 months. Patients that had not received prior osteoporosis treatment presented greater functional loss at 6 months, while poorer control of glomerular filtration was observed for those patients with higher levels of functional loss at 18 months. Patients with higher levels of functional loss presented a longer average length of stay, severe to high levels of dependence, longer surgical delay, more severe delirium on admission and had received lower levels of osteoporosis treatment on discharge. Patients who were sent straight home on discharge presented lower levels of functional loss at 6 and 18 months.

Table 5 describes the factors that predict functional loss at the 6 and 18 month FLS follow-up appointments. Multivariate adjusted regression models showed the following factors to be independently associated with a poorer prognostic of functional recovery at 6 months: to be sent to a care home on discharge, severe prior levels of dependence, a Pfeiffer SPMSQ score of >2 on admission, delirium during admission, protein undernutrition on admission and a lack of osteoporosis treatment, either prior to admission or after discharge. The factors independently associated with greater functional loss at 18 months were: to be discharged to a care home, a Pfeiffer SPMSQ score of >2 on admission, a severe level of dependence on discharge, history of acute myocardial infarction, GFR<30 ml/min/1.73m^2 and no osteoporosis treatment received on discharge.

4. DISCUSSION:

Implementation of the FLS and Multidisciplinary Clinical Guidelines meant improvements on the follow-up and treatment of osteoporosis in patients with fractured femurs. In 2017, the Spanish National Hip Fracture Register (RNFC) was established. An analysis of the results of the RNFC working group enables us to assess and compare them to our results, and find those

areas in which there remains room for improvement[14]. The patients admitted to our unit were of very advanced age, mostly women who still lived at home and had only a slight level of pre-fracture dependency, as described in other publications[15]. The kinds of fracture and types of implant used in our hospital are the same as for other published series[16]. Likewise, the medical complications encountered are congruent with those featured in the literature[17], with delirium being the complication most commonly found. The average length of stay and average surgical delay were slightly longer than the average for the RNFC and other national publications[18]. The surgical delay experienced for administrative reasons evidences the need to increase the availability of operating theatres and staff able to operate on patients on bank holidays and weekends. 70% of patients received osteoporosis treatment on discharge, a level which is far higher than the RNFC average, with a variability of 0 to 93.9% from one hospital to another, and when compared to the results of other Spanish registers[19]. Implementation of the clinical guidelines to improve osteoporosis treatment reduced complications, average length of stay, mortality and the risk of refracture at two years[20,21]. The levels of depression and cognitive deterioration we recorded were higher than previously published in the literature[22], which we attribute to the fact that the number of patients with preoperative depression was also somewhat higher (29.3%). The clinical and analytical improvement data observed at the 18-month follow-up may be related to the fact that, precisely, the healthiest individuals are those who have healed from the femur fracture, and who take less psychotropic medication.

Our levels of compliance with osteoporosis treatment are very similar to the average level of therapeutic adherence for Spain. The Catalan Integrated Health Consortium (CSI) FLS offers an 18-month follow-up period. Most of the post-fracture follow-up programmes reported in the literature between 2003 and 2020 offer a one-year follow-up and show a lower level of adherence if they do not provide an FLS. Despite the good levels of adherence, we see that the most frequent cause of non-compliance is when the treatment is changed by Primary Care (65-

85%). This evidences the need for fluid communication between the FLS and Primary Care physicians, either through clinical records, email or telephone calls[23]. The COVID 19 pandemic made the need for the telematic follow-up of patients with fragility fractures clear in order to achieve a good level of adherence, compliance and coordination with the Primary Care services [24]. The present study shows that the patients who actually attend their follow-up appointments achieve better levels of compliance with respect to their osteoporosis treatment, and were less frequently readmitted during the follow-up period. A recent European study showed that patients attending an FLS at 12 months suffered fewer multiple falls and had a lower rate of attending in the emergency department. The patients who came to our FLS presented fewer second fractures at their 18-month follow-up appointment. Previous studies found a lower risk of non-vertebral fractures compared to patients that had not attended a Fracture Liaison Service, a reduction of 56% at two years of follow-up [25,26]. More recent studies have shown a reduction of 30% for all kinds of fracture, and 40% for major refractures in patients who attended their follow-up appointments at an FLS, as well as a reduced mortality[27]. The FLS model has been shown to result in greater persistence with osteoporosis treatment up to five years after discharge[28].

A systematic review identified up to 25 prognostic factors that predict functional loss after fracturing a hip[29]. Cognitive status on admission and anaemia are the two prognostic factors with the greatest body of evidence. The presence of cognitive deterioration and delirium are related to finding greater functional loss at follow-up appointments. These findings coincide with those of other publications and highlight the importance of preventing delirium to improve functional recovery in the short and mid-term. The worse nutritional status is on admission, the greater the functional loss on discharge, and during the follow-up period[30]. The RNFC has already published data showing that patients housed in care homes and with a lower functional

status on discharge, as well as cognitive deterioration, present greater functional loss in the first month of follow-up[31].

Patients discharged to a care home presented with a greater functional loss throughout the follow-up period. This is a finding already reported by other authors[32]. It could either be attributed to patients being in a worse state on admission or having had less rehabilitation during the follow-up period.

In our study, poorer glomerular filtration was associated with a lower level of functional development throughout the follow-up period. Studies recommend investigating and controlling PTH levels in all patients with reduced GF to limit the risk of new fractures[33].

Patients that received no osteoporosis treatment on discharge presented greater functional loss during the follow-up period. Recent studies have described FLSs as the ideal instrument with which to assess the imminent risk of fracture, and to optimise osteoporosis treatment and prevent the appearance of fresh fractures[34].

Limitations of the study:

Our study did not record access to home rehabilitation neither for patients discharged to their own home, or to another place of care. Consequently, we are unable to determine whether the location on discharge may or may not have influenced access to functional rehabilitation during the follow-up period.

Our study did not use any kind of fragility index when appraising our patients. It would be of interest to perform a prospective study to seek the relationship between fragility, functional loss and quality of life for patients with fractures of the femur.

5. CONCLUSION:

The independent predictors of functional loss in the follow-up of elderly patients with femur fractures at 6 and 18 months were institutionalisation, severe dependence either prior to and on discharge, delirium, protein malnutrition, prior acute myocardial infarct, GFR<30 ml/min/1.73m^2 and not receiving treatment for osteoporosis on discharge.

A lower incidence of refractures, a lower readmission rate and a better treatment compliance were observed in patients attending follow-up visits, pointing to the benefits of the implementation of clinical guidelines including a structured follow-up of these patients at discharge.

Identifying the factors associated with a greater functional loss may contributes to improve the healthcare model and to enhances coordination with the Primary Care services, thus enabling to offer the patients a better quality of life.

Conflict of Interest Statements

The authors have indicated that they have no conflicts of interest regarding the content of this article.

Table 1: Baseline characteristics of the patients included in the study (n=478)

Sociodemographic data

Age	85.6±6 years (58-101)
Gender	
Male	139 (29%)
Female	339 (71%)
Provenance	
Home	895 (74.8%)
Nursing home	232 (19.4%)
Acute hospitalization	31 (2.6%)
Long-term hospital care	36 (3%)
Marital status	
Widowed	303 (65.4%)
Married	121 (25.3%)
Single	43 (8%)
Divorced	11 (1,4%)
Household and family status	
Alone	113 (24%)
Accompanied	275 (58%)
Nursing home	90 (18%)
Education	
Illiterate	58 (11.8%)
Read/write	329 (69.5%)
Primary	77 (15.9%)
Higher	14 (2.8%)
Architectural barriers	
Yes	247 (51.7%)

Clinical data

Kind of fracture	
Pertrochanteric	215 (44.9%)
Subcapital	184 (38.4%)
Subtrochanteric	24 (5.19%)
Periprosthetic	31 (6.5%)
Supracondylar-diaphyseal	19 (4%)
Acetabulum	5 (1.04%)
≥1 Fracture on admission	27(5,6%)
Fractures prior to admission	29(6%)
Transfusion on admission:	338 (28.7%)
Type of implant	
Intramedullary nail	183 (38.2%)
Hemiarthroplasty	153 (32%)
DHS-dynamic hip screw	56 (11.7%)
Total hip replacement	16 (3.34%)
Cannulated screws	3 (0.62%)
Conservative management	29 (6%)
Liss plate	16 (3.3%)
No implant	22 (4.6%)
ASA Risk	
I-II	323 (67.7%)
III-IV	155 (32.3%)
Post-Surgical Rehabilitation	
Authorised loading	391 (81%)
Pre-fracture Barthel Index	
Midly dependent	338 (70.6%)
Moderate dependent	86 (17.8%)
Severe/total dependent	54 (11%)
Barthel Index on discharge	
Midly dependent	96 (12.7%)
Moderate dependent	124 (28.7%)
Severe/total dependent	212(49.2%)
Charlson Index Mean(SD)	2.2±1.9
Categorised Charlson Index	
<2	204 (42.6%)
≥2	274 (57.4%)
MNA	
24-30	300 (62.7%)
17-23	130 (27.1%)
<17	23 (4.8%)
Missing	25 (5.2%)
Blood test	
Calcium	2.2±0.37 mmol/L
Calcidiol	13.96±9.9ng/mL
Protein	57±6g/L
Albumin	26.6±4.2g/L
Hb	10.2±1.54g/L
EGF	63.7±21.26ml/min/m^2
(Estimated Glomerular Filtration)	
Anaemia on admission:	91 (19%)
Pressure Ulcers admission:	27(6.5%)
Pfeiffer Test	
0-2	223 (46.7%)
>2	255 (53.3%)
Complications	
Delirium	153 (32.5%)
Heart failure	61 (13%)
Bronchospasm	52 (11%)
Exacerbated COPD	18 (3.8%)
Urinary retention	60 (12.7%)
Kidney failure	115 (24.4%)
Anaemia	228 (47.7%)
Electrolytic alterations	29 (6.1%)
Nosocomial infection	145 (29.3%)
Osteoporosis treatment on admission	
Yes	123 (26.2%)
Osteoporosis Treatment on discharge	
Oral bisphosphonates	123 (28.4%)
IV bisphosphonates	80 (18.7%)
Denosumab	53 (11.8%)
Teriparatide	42 (9.8%)
Calcium and vitamin D only	136 (31%)

Care management parameters

Length of stay, mean (SD)	14.3 ±7.5 days
Median length of stay	13 days (1-62)
Stay >15 days	133 (28.1%)
Destination on discharge	
Geratric Rehabilitation Unit	225 (52.8%)
Long-term hospital care	50 (11.7%)
Nursing home	92 (21.6%)
Home	59 (13.8%)
Exitus	46 (9.7%)
Surgery in <48 hours:	155(32.4%)
Delay (mean)	3.7 days (0-20)
Causes for surgical delay	
Administrative	189 (40.3%)
Infrastructure	104 (22%)
Weekend -Bank holiday	85 (18%)
Anticoagulants	86 (18.2%)
Descompensated chronic disease baseline	24(5.1%)

Table. 2: Description of FLS follow-up appointments at 6 and 18 months

	FLS 6 months n=432	**FLS 18 months n=364**
Attend appointment	282 (65.3%)	208 (57.3%)
Functional		
Barthel Index FLS appointment (aBI)	52±29	54.3±29
Pre-fracture Barthel Index (PfBI)	74±23	76.6±22.8
Functional loss (PfBI-aBI)	23.15±22.5	21.44±19.57
Lawton-Brody Scale Categorised		
0 : total dependence	43 (12%)	32 (11.2%)
1-7: partial dependence	163 (45.4%)	140 (49.1%)
8: fully independent	153 (42.6%)	113 (39.6%)
***Walk** (yes)*	270 (74.2%)	229 (78.7%)
***Get up and Go** (")*	20.17±6.16	20.81±6.35
Blood tests		
Calcium (mmol/L)	2.29±0.12	2.28±0.11
Calcidiol (ng/mL)	44.2±32	47.7±27.2
Protein (g/dL)	66.5±6.6	67.3±5.9
Albumin (g/dL)	33.7±5.6	34.5±4.6
Hb (g/dL)	12.1±1.5	12.7±4.39
PTH (pg/mL)	46.5±31	61.1±10.5
EGF (ml/min/1.73 m2)	65±18.2	62.7±17.50
Transferrin saturation (%)	28.9±8.2	32.2±5.8
Mental		
Cognitive Impairment	124 (34.1%)	96 (33.1%)
Depression	72 (19.7%)	48 (16%)
Social		
Move home	98 (26.8%)	66 (22.8%)
Death	68(15.8%)	69 (19.1%)
Readmission	43 (11.6%)	60 (20.3%)
Falls	84 (23.1%)	117 (40.1%)
New fractures	9 (2.5%)	29 (9.9%)
Drugs		
Benzodiazepines	105 (28.9%)	85 (29.4%)
Neuroleptics	117 (32.1%)	81 (27.8%)
Antidepressants	118 (32.4%)	89 (30.6%)
Osteoporosis treatment		
Compliance	298 (81.4%)	225 (77.3%)
Causes for non-compliance		
Changed by primary care centre	(65%)	(85.3%)
No access	(22.4%)	(5.6%)
Intolerance	(3.4%)	(0%)
Lack of adherence	(8.6%)	(8.8%)
Change of meds to	35 (13.1%)	18 (6.4%)
Oral Bisphosphonates	5 (14.2%)	6 (33%)
IV Bisphosphonates	12 (34.2%)	2 (11.1%)
Denosumab	3 (8.57%)	3 (16.6%)
Calcium and-vitamin D only	15 (42.8%)	7 (39%)
Calcium and-vitamin D	328(89.9%)	251 (86.3%)

Table.3 Attendance of follow-up appointment at FLS

	Patients attending outpatient FLS follow up appointments at 6 months		
	YES (n=282, 65.3%)	**NO (n=150, 34.7%)**	***p***
Compliance with osteoporosis treatment (n=298)	240 (85.4%)	58 (38.6%)	0.0003
Patients readmitted for any reason (n=43)	20 (7%)	23 (15.3%)	0.006
Patients with new fractures caused in any way (n=9)	5 (1.7%)	4 (2.6%)	0.61
	Patients attending outpatient FLS follow up appointments at 18 months		
	YES (n=208, 57.3%)	**NO (n=156, 42.7%)**	***p***
Compliance with osteoporosis treatment (n=225)	187 (89.9%)	38 (24.3%)	0.00006
Patients readmitted for any reason (n=60)	20 (9.6%)	40 (25.6%)	0.0001
Patients with new fractures caused in any way (n=29)	10 (4.8%)	19 (12.1%)	0.00004

Table 4: FACTORS RELATED TO LOSS OF FUNCTIONAL CAPACITY AT 6 AND 18 MONTH FLS FOLLOW-UP VISITS: **bivariate analysis**

	Functional loss at 6 months(†) n=352			Functional loss at 18 months(†) n=285		
BASELINE CHARACTERISTICS OF PATIENTS [1]	**FL≤20** n=177	**FL>20** n=175	***p***	**FL≤20** n=142	**FL>20** n=143	***p***
Age in years (mean ± SD)	83.8±5.6	86±5.8	**0.0003**	82.9±5.6	85.7±5.6	**0.000036**
≤82	69 (39%)	53(30.1%)	0.34	64 (45.1%)	42 (29.4%)	
82-88	72 (40.7%)	56(31.8)		56 (39.4%)	52 (36.4%)	
>88	36 (20.3%)	67 (38.1%)		22 (15.5%)	49 (34.3%)	
Gender (women)	133 (77.8%)	121 (70.8%)	0.13	104 (50.5%)	102 (49.5%)	0.37
Marital status (married)	54 (31.8%)	38(22.2%)	**0.047**	46 (34.3%)	32 (22.7%)	**0.032**
Provenance-Place of residence						
Home	132 (74.6%)	126 (71.6%)	**0.005**	110 (77.5%)	101 (70.6%)	**0.0003**
Nursing Home	22 (12.4%)	40 (22.7%)		11 (7.7%)	33 (23.1%)	
Long-Term hospital care	23 (13%)	10 (5.7%)		21 (14.8%)	9 (6.3%)	
Education (illiterate)	14 (8%)	24 (14%)	0.29	8 (5.8%)	20 (14.3%)	0.12
Architectural barriers (yes)	89 (50.3%)	94 (53.4%)	0.55	73 (51.4%)	74 (51.7%)	0.95
Type of fracture						
Subcapital/ Pertrochanteric	146 (82.5%)	143 (81.3%)	0.76	118 (83.1%)	114 (79.7%)	0.46
Other fractures	31 (17.5%)	33 (18.8%)		24 (16.9%)	29 (20.3%)	
Type of implant						
Hemiarthroplasty	58 (32.8%)	67 (32.1%)	0.58	51 (35.9%)	51 (35.9%)	0.74
Intramedullary nail	99 (55.9%)	96 (60.5%)		78 (54.9%)	77 (53.6%)	
Conservative	20 (11.3%)	13 (7.4%)		13 (9.2%)	15 (10.5%)	
Prior comorbidity						
Charlson Index (mean±SD)	1.7±1.4	2±1.6	0.12	1.6±1.5	2±1.6	**0.042**
Complex diabetes	3 (1.7%)	2 (1.1%)	1	2 (1.4%)	3 (2.1%)	0.65
COPD	14 (8%)	18 (10.3%)	0.44	11(7.9%)	9 (6.4%)	0.63
Heart failure	30 (17.1%)	23 (13.2%)	0.30	18 (12.9%)	19 (13.5%)	0.67
Dementia	29 (16.6%)	65 (37.4%)	**0.000012**	18 (12.9%)	50 (35.5%)	**0.00001**
Chronic kidney failure	28 (16%)	31 (17.8%)	0.65	20 (14.3%)	27 (19.1%)	0.27
Cerebrovascular disease	31 (17.4%)	30 (17.2%)	0.9	22 (15.7%)	25 (17.7%)	0.65
Myocardial Infarction	11 (6.3%)	21 (12.1%)	**0.06**	5 (3.6%)	16 (11.3%)	**0.013**
Severe hepatopathy	2 (1.1%)	2 (1.1%)	1	2 (1.4%)	2 (1.4%)	0.99
Nutritional values (MNA Score)						
<17: malnutrition						
17-23:at risk of malnutrition	7 (4.1%)	6 (3.6%)	0.18	71 (52.2%)	100 (72.5%)	**0.002**
≥24: normal	103 (60%)	115 (69%)		58 (42.6%)	34 (24.6%)	
	62 (36%)	45 (27%)		7 (5.1%)	4 (2.9%)	
Pre-fracture functional parameters (Categorised BI)						
Midly dependent	45 (26.5%)	11 (6.7%)	**0.0001**	14(10.2%)	12 (8.6%)	0.15
Moderate dependent	62 (36.5%)	49 (30.1%)		12 (8.8%)	23 (16.4%)	
≥ Severe dependent	63 (37%)	103 (63.2%)		111 (8.1%)	105 (75%)	
Pfeiffer SPMSQ on admission						
0-2	120 (78.9%)	66 (56.4%)	**0.0003**	102 (82%)	59(59%)	**0.01**
3-4	13 (8.6%)	23(19.7%)		10 (8.1%)	19 (19%)	
>4	19 (12.5%)	28 (23.9%)		12 (9.7%)	22 (22%)	
CAM test on admission						
Negative: absence of delirium	146 (84.4%)	117 (69.6%)	**0.001**	121 (88.3%)	100 (71.9%)	**0.001**
Positive: presence of delirium	27 (15.6%)	51 (30.4%)		16 (11.7%)	100 (71.9%)	
Previous fractures						
Last year	13 (7.5%)	8 (4.7%)	0.27	10 (7.3%)	7 (5%)	0.42
General	21 (12.1%)	25(14.7%)	0.48	14 (10.2%)	24 (17.1%)	**0.094**
>1 fracture on admission	7 (4%)	10 (5.7%)	0.44	5 (3.5%)	9 (6.3%)	0.27
ASA Risk						
Categorised average III-IV	43 (24.9%)	44 (25%)	0.92	28 (20.3%)	33 (23.4%)	0.52
Blood tests						
Calcium (mmol/L)	2.3±0.5	2.2±0.1	**0.018**	2.3±0.6	2.2±0.1	**0.082**
Calcidiol (ng/ml)	15.3±11.1	13.8±8.7	0.52	15.5±11	14.1±9.2	0.36
Total proteins (g/dL)	57.9±5.9	56.3±5.7	**0.01**	57.8±5.9	57±5.8	0.24
Albumin (g/dL)	27.4±3.6	26±4	**0.03**	27.4±3.8	27.2±3.7	0.61

Hb(g/dL)	10.3±1.5	10.2±1.5	0.55	10.3±1.5	10.4±1.6	0.55
EGF(mL/min/1.73m2)	67.8±19.9	66.8±19.4	0.47	69.9±19.9	65.1±20.3	**0.0025**
Prior osteoporosis treatment						
Yes	26 (14.9%)	10 (5.8%)	**0.005**	19 (13.5%)	13 (9.3%)	0.26
	Functional loss at 6 months			**Functional loss at 18 months**		
Characteristics of process variables	**FL≤20**	**FL>20**	***p***	**FL≤20**	**FL>20**	***p***
Length of stay (mean±SD)days	13.8±6.9	14.7±7.6	**0.06**	13.1±5	14.3±6.2	**0.07**
Length of stay>15 days	39(22.4%)	47 (26.9%)	0.33	29 (20.9%)	36 (25.4%)	0.37
Rehabilitation high load	156 (88.1%)	152 (86.4%)	0.61	125 (88.7%)	119 (83.2%)	0.18
Functional parameters on discharge (Categorised BI)						
Midly dependent	45 (26.5%)	11 (6.7%)	**<0.0001**	41 (30.4%)	14 (10.4%)	**<0.0001**
Moderate dependent	62 (36.5%)	49 (30.1%)		55 (40.7%)	39 (28.9%)	
≥ Severe dependent	63 (37%)	103 (63.2%)		26 (19.3%)	59 (43.7%)	
Surgical delay (days)						
Mean±SD	3.4±2	4±2.3	**0.03**	3.4±2	4±2.2	**0.035**
Osteoporosis treatment on discharge			**0.000018**			**0.000035**
With treatment	53 (30.3%)	57 (32.9%)		30 (21.4%)	55 (39.3%)	
Oral bisphosphonates	48 (27.4%)	28 (16.2%)		44 (31.4%)	27 (19.3%)	
IV Zoledronate	28 (16%)	18 (10.4%)		26 (18.6%)	13 (9.3%)	
Denosumab	27 (15.4%)	16 (9.2%)		26 (18.6%)	14 (10%)	
Teriparatide	19 (10.9%)	54 (31.2%)		14 (31%)	31 (22.1%)	
No treatment on discharge (Ca+vitD)						
	Functional loss at 6 months			**Functional loss at 18 months**		
Characteristics of outcomes assessed	**FL≤20**	**FL>20**	***p***	**FL≤20**	**FL>20**	***p***
Medical complications						
Delirium	30 (17.1%)	61 (35.1%)	**0.00013**	24 (17.1%)	38 (27%)	**0.047**
Acute urinary retention	19 (10.9%)	11 (6.3%)	0.25	13 (%)	19 (%)	0.26
Heart failure	13 (7.4%)	18 (10.3)	0.33	9 (6.4%)	15 (10.6%)	0.20
Bronchospasm	9 (5.1%)	11 (6.3%)	0.63	4 (2.9%)	10 (7.1%)	0.10
Exacerbated COPD	3 (1.7%)	8 (4.6%)	0.12	2 (1.4%)	6 (4.3%)	0.15
Acute kidney failure	28 (16%)	35 (20%)	0.31	21 (15%)	27 (19.1%)	0.35
PE-DVT	3 (1.7%)	0	0.24	2 (1.4%)	1 (0.7%)	0.55
Nosocomial infection	43 (24.6%)	48 (27.6%)	0.52	31 (22.1%)	40 (28.4%)	0.23
Complications of surgical wound	16 (9.2%)	19 (11.2%)	0.55	10 (4.2%)	17 (12.1%)	0.16
Pressure ulcers - PU						
PU on admission	12 (6.8%)	5 (2.8%)	**0.08**	7 (4.9%)	9 (6.3%)	0.61
PU on discharge	14 (7.9%)	19 (10.8%)	0.35	10 (7%)	15 (10.5%)	0.30
Destination on discharge						
Home	38 (21.5%)	13 (7.4%)	**0.000034**	34 (23.9%)	12 (8.4%)	**0.000009**
Nursing home	24 (13.6%)	52 (29.5%)		13 (9.2%)	41 (28.7%)	
Long-term hospital care	16 (9%)	20 (11.4%)		13 (9.2%)	17 (11.9%)	
Geriatric Rehabilitation Unit	99 (55.9%)	91 (51.7%)		82 (57.7%)	73 (51%)	

(1) Results on the different variables are shown after excluding missing values, only for available data

(†): exitus previous to the follow-up visit have been excluded

***"P"*-value in bold indicated a statistically significant difference in the variable between both groups (FL≤20 and FL>20)**

EGF: estimated glomerular filtration

PE-DVT: pulmonary embolism – deep vein thrombosis

Table 5. Logistic regression analyses of independent factors predicting functional loss at 6 and 18 months

	FLS appointment at 6 months (‡)		FLS appointment at 18 months (‡)	
Factors predicting functional loss	**OR (CI = 95%)**	**p**	**OR (CI = 95%)**	**p**
Destination on discharge		**0.003**		**0.027**
Nursing home	1		1	
Geriatric Rehabilitation Unit	0.300 (0.129-0.702)	0.006	0.407(0.165-1.001)	0.050
Home	0.152 (0.050-0.460)	0.001	0.213(0.067-..672)	0.008
Long-term hospital care	0.732 (0.230-2.332)	0.598	1.016(0.304-3.399)	0.979
Prior Bathel Index		**<0.0005**	-	-
Mildly dependent and total autonomy	1		-	-
Total and Severe dependent	0.050(0.016-0.163)	<0.0005	-	-
Moderate dependent	0.473(0.209-1.072)	0.073	-	-
Pfeiffer SPMSQ on admission		**<0.0005**		**0.009**
0-2	1		1	
remainder	4.173(2.251-7.734)	<0.0005	2.521(1.261-5.038)	0.009
Barthel Index on discharge	-	-		**0.049**
Total dependent	-	-	1	
Mildly dependent	-	-	1.378(0.346-5.485)	0.649
Moderate dependent	-	-	1.796(0.569-5.667)	0.318
Severe dependent	-	-	3.379(1.169-9.765)	0.025
Prior Myocardial Infarction (Yes *vs.* No)	-	-	5.719(1.580-20.700)	**0.008**
Delirium during admission	**1.907 (1.006-3.615)**	**0.048**	-	-
Proteins	0.955(0.911-1.002)	**0.058**	-	-
Prior Osteoporosis treatment		**0.023**	-	-
Any treatment	1		-	-
No treatment	2.968(1.162-7.583)	0.023	-	-
Osteoporosis treatment on discharge		**0.002**		**0.044**
Teriparatide	1		1	
IV bisphosphonates	1.003(0.379-2.649)	0.996	1.118(0.415-3.011)	0.825
Oral bisphosphonates oral	1.501(0.575-3.919)	0.407	2.276(0.861-6.015)	0.097
Denosumab	1.237(0.418-3.663)	0.701	0.568(0.182-1.770)	0.329
No	6.057(1.981-18.525)	0.002	2.144(0.645-7.128)	0.213
Initial Estimated Glomerular Filtration (<30ml/min/m^2)	-	-	0.982(0.967-0.998)	**0.028**

. **(‡): only variables reaching statistical significance or close to it (p<0.1) in the bivariable analysis were considered for the logistic regression models**

. ***"p"*value in bold indicates a statistically significant result**

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