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# Checklist for prevention of new hip fractures

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## Summary
*Introduction:* Hip fracture is the worst complication of osteoporosis and especially affects postmenopausal women in the developed world. Previous studies have shown low rates of initiating osteoporosis treatment during hip fracture hospitalization.
*Objective:* To probe the effectiveness of the so-called hip fracture checklist in increasing the rate of the initiation of osteoporosis treatment compared with the previous two years.
*Methods:* Rates of initiating treatment among a population of one hundred postmenopausal women over 60 years of age surgically treated after suffering a hip fracture. Comparison of rates of prescription in our hospital before and after initiating the current study.
*Results:* In 2006, 1.66% of the patients were discharged from hospital with a new treatment for osteoporosis. In 2007, the rate was 6.9%. The age of our patients was 80.4 years. All of them were diagnosed during hospitalization with either osteoporosis (61.9%) or osteopenia (38.1%), but only 13% of them were previously diagnosed with osteoporosis, 10% of them were taking calcium and vitamin D, and 2% bisphosphonates. At the time of discharge, we prescribed calcium and vitamin D to all the patients (100%), and bisphosphonates (oral or parenteral) to the 94.6% of them.
*Conclusions:* The results show a significant increase in rates of antiosteoporotic drugs prescription compared with the previous two years. The implementation of the hip fracture checklist clearly increases the likelihood of starting osteoporosis treatment post hip fragility fracture.

**Key words:** *fragility hip fracture, osteoporosis, osteoporosis treatment.*

## Introduction

Osteoporosis is characterised by the structural deterioration of bone tissue which leads to a loss in resistance which increases the susceptibility of suffering fractures. Both women and men are affected, although 80% are postmenopausal women[1]. The National Foundation for the study of Osteoporosis (NOF) estimates that 10 million people in the US suffer from osteoporosis and that approximately 34 million more have a greater risk of suffering from it due to low bone mass[2]. The data regarding osteoporotic fractures in Spain which started to circulate in the final years of the last century, referring to a period of one year, referenced approximately 30,000 to 40,000 fractures of the proximal end of the femur, 70,000 vertebral fractures and 25,000 fractures of the distal end of the radius. After the AFOE (Acta de Fracturas Osteoporóticas de España – Record of Osteoporotic Fractures in Spain) study endorsed by the GEIOS (Grupo de Estudio e Investigación en Osteoporosis de la Sociedad Española de Cirugía Ortopédica y Traumatología – Study and Research Group on Osteoporosis of the Spanish Society of Orthopaedic Surgery and Traumatology) and from the results of a survey carried out in 2003 in 77 hospitals in the different Autonomous Communities of Spain, it has been possible to confirm that these figures are already far from the reality, and have seen a notable increase, such that the number of fractures of the proximal third of the femur in those over 60 years increases to more than 60,000 a year[3].

Fractures of the hip are associated with a significant risk of mortality in the first year of between 15 and 33%, attributable to factors as variable as deep vein thrombosis, pulmonary embolism, pneumonia, a general state of deterioration and deficient rehabilitation. The ratio of mortality increases with the age of the patient (by 4% for each year of life), the period of delay before surgery (, 2 days: 4%; >4 days: 6.1%), and the comorbidity of admission (e.g., 40% of mortality in the first year in the case of congestive cardiac failure).

An osteoporotic hip fracture is very often the first sign of osteoporosis and always an alarm call. The follow up of patients with osteoporosis, above all if there is an earlier fracture, is very important in achieving a good development of the disease and, therefore, a lower level of incapacity in this type of patient.

Initial fragility fractures lead to an increased risk of suffering future fractures[1]. In a study carried out in more than 30,000 patients with home care in North Carolina (US), it was found that 23.9% of those patients with hip fracture and 15.1% of patients with other types of fracture experienced a second fragility fracture in the following two years[4]. In another follow up study of 22 years duration of 766 women with hip fractures, 45% suffered a second fracture[5].

The objective of this study is to assess the implementation of secondary prevention of osteoporotic fracture of the hip after raising the awareness of medical and nursing staff, and family and social workers through the introduction of a clinical pathway, discharge checklist or hip fracture checklist (Table 1).

## Material and method

A unicentric prospective observational study, initiated as a consequence of the start of a doctoral thesis project by the first author of this article in a tertiary hospital. The study included 100 postmenopausal women over 60 years of age with osteoporotic fracture of the proximal third of the femur (after low intensity trauma), treated in our centre (University Hospital of the Canaries) during the period from January 2008 to June 2010. The inclusion and exclusion criteria were the following:

– *Inclusion criteria:*

1. Postmenopausal women over 60 years of age.
2. Admitted due to having presented with a low energy (fall from their own height or less) fracture of the proximal third of the femur.
3. Ability to walk before the fracture, and having both legs.
4. Signature of informed consent

– *Exclusion criteria:*

1. Hip fracture having been treated with surgical intervention with the presence of osteosynthetic material or prosthesis in the healthy hip.
2. Creatinine clearance <30 ml/min and corrected calcemia >11 mg/dl or <8 mg/dl.
3. Active neoplasm, active infection or bone metabolic pathology.
4. Life expectancy less than 6 months according to the researcher's criteria.

*Activity protocol*

Once the patient was stabilised from a medical point of view, the surgical intervention proceeded (osteosynthesis or partial or total substitution arthroplasty). A complete clinical history was taken, focusing on risk factors for osteoporosis, in addition to routine analytical tests and tests specific to bone metabolism, before and after surgery. Among the tests was one for blood vitamin D (25 dihydroxyvitamin D) using radioimmunoassay (BIOSOURCE®), a technique whose sensitivity was 0.6 ng/ml.

Bone densitometry was performed using dual energy X-ray absorptiometry (DXA), Hologic® QDR-2000 system (software version 5.54), when the patient was postoperatively mobile. The bone mineral content (BMC) and bone mineral density (BMD) were determined in the lumbar spine (L2, L3, L2-L4), and in the proximal femur of the non-fractured hip. Those patients who had a T-score lower than -2.5, were defined as osteoporotic according to the criteria of the WHO and incorporated in the principal guides[1]. The results are expressed in Table 1, taking as a reference the values described as normal for bone mass in our country[6].

The percentages of patients who had been diagnosed previously with osteoporosis, and whether they had taken any kind of treatment for it,

Table 1. Densitometric values of the patients studied

| N=100 | T-score neck | T-score trochanter | T-score total hip | T-score L2-L4 | BMD neck | BMD total hip | BMD lumbar spine |
|---|---|---|---|---|---|---|---|
| Average | -2.17 | -1.13 | -1.89 | -0.508 | 0.68147 | 0.72943 | -0.90934 |
| Median | -2.50 | -1 | -1.750 | -0.450 | 0.68050 | 0.76700 | 0.89000 |
| Deviation | 1.1286 | 0.7208 | 1.0662 | 1.1432 | 0.126801 | 0.110397 | 0.166344 |
| Minimum | -4.4 | -2.8 | -3.8 | -2.8 | 0.420 | 0.497 | 0.552 |
| Maximum | 0.3 | 0.1 | 0.3 | 1.1 | 0.978 | 0.915 | 1.258 |

BMD: bone mineral density ($g/cm^2$).

were analysed. The sufficient level of intake of calcium was established at more than 2 rations a day, which the literature describes as ensuring an intake of at least 1,200 mg of calcium element a day[7].

Prior to the study, a retrospective review was carried out of patients with hip fracture discharged from our hospital in previous years, to see which were discharged with calcium/vitamin D and bisphosphonates. Specifically for the aims of this study, a hip fracture checklist was introduced (Table 2).

*Statistical method*

The data were analysed using the software programme SPSS 15.0. We proceeded first to determine if the variables had a normal distribution or not by means of the Kolmogorov – Smirnov test. Although most of the women had a Gaussian distribution, some hormones and markers for bone synthesis and resorption had a non-parametric distribution. Therefore, for the univariant inferential statistical analysis we used, with a normal distribution, Student's t test to compare one variable between two groups and the ANOVA test in the case of three or more groups, and subsequently the Student-Newman-Keuls test to discern between which groups differences were established, and Pearson's correlation to analyse the relationship between two quantitative parameters. Given the relationship between BMD and age, a covariance study was carried out with this parameter. In the case of non-parametric distributions, the Mann-Whitney U test was used to analyse the differences between two groups, and Kruskall-Wallis to analyse the differences between three or more groups, as well as Spearman's correlation.

Once the individual prognostic value for each parameter was established, a Cox regression study was then carried out to understand which of those showing a prognostic value in the univariant analysis also had it in the mutlivariant analysis.

There was also an analysis of whether the change in the values of the different variables determined at the start and at 6 months had any prognostic relationship through a general linear analysis model for repeated measurements. This analysis was also carried out to see the influence of alcoholic abstention on these variables. Subsequently, the patients were classified according to the gain or loss of bone mass at 6 months from the start of the study, analysing the prognostic value and the effect of abstinence using Kaplan and Meyer curves, the Log Rank test, and the Breslow test. Finally, we carried out a Cox multivariant test, including, among other parameters, abstinence, to compare the results obtained with the changes in the variables analysed and to confirm whether they had independent prognostic value or not.

## Results

The patients in the study who had fractured their hip were elderly (average age 80.4 years), most living at home (where the fracture occurred), were sedentary, 40% of whom were receiving some kind of home help, and the same proportion had some degree of cognitive deterioration. 75% of them did not consume the minimum daily requirement of milk products, having an intake of two or less portions per day (Figure 1) and more than 50% had reduced values of vitamin D, meaning levels lower than 30 ng/ml (Figure 2).

After carrying out a DXA on admission, whose results are shown in Table 1, 61.9% had osteoporosis (Figure 3), but only 13% had previously been diagnosed with osteoporosis.

As regards the taking of treatment for osteoporosis previously, the results indicate that 10% received daily calcium and vitamin D and 2% oral bisphosphonates.

After the initiation of our study with the implementation of the checklist 94.6% of our patients were prescribed bisphosphonates on discharge:

Table 2. Checklist of the multidisciplinaryhip fracture team

ON ADMISSION:

1. Admission and preoperative phase: haemogram, coagulation study, ECG, thoracic X-ray, anteroposterior pelvic X-ray and axial X-ray of fractured hip.
2. Informed consent for surgery and blood transfusion.
3. Suspend antiaggregant/anticoagulant medication.
4. Provide the following appropriate medication:
   - Thromboembolic prophylaxis
   - Analgesia
   - Gastric protection
5. Carry out an interconsultation with Anaesthesiology.
6. Intervention within 48 hours improves medical conditions (interconsultation with Internal Medicine if associated comorbidity).

POSTSURGICAL:

7. Appropriate medication:
   - Endovenous analgesia
   - Thromboembolic prophylaxis
   - Gastric protection
   - Endovenous antibiotherapy (maximum of 48 hrs)
8. Endovenous vitamin D.
9. 24 hour serotherapy.
10. 24 hours seated.
11. Control X-ray and interconsultation with Rehabilitation.
12. Haemogram and basic biochemistry at 48 hours.
13. Remove drips, probes, first dressings and deambulation within 48 hours.

ON DISCHARGE:

14. Appropriate medicine:
   - Oral analgesic
   - Thromboembolic prophylaxis
   - Gastric protection
   - Home treatment
   - Calcium and vitamin D
   - Oral bisphosphonates (no earlier than two weeks from the fracture)
15. Appointment at the traumatology outpatients clinic.
16. Continuing rehabilitation treatment.
17. Appointments in other outpatient clinics requested.
18. Control X-ray.

19. ATTACHED RECOMMENDATIONS TO THE PATIENT OR FAMILY:
   - Lifestyle changes: regular exercise, stop smoking and minimise alcohol intake, stop taking sedatives and psychotropic drugs.
   - Assess the risk of falls in the home (slippery floors, poor lighting, domestic pets, etc.), eliminate sedative or psychotropic drugs, correct defective vision, use of crutches or walking frame.
   - List of questions for the patient to ask their FAMILY DOCTOR:

1. Have I had a recent fracture. Do I suffer from osteoporosis?
2. Do I need to have a test to discount it?
3. Do I need to take more calcium or vitamin D?
4. What can I do to prevent falls?
5. What will you prescribe me for osteoporosis?

80.7% taking a single weekly dose of 75 mg risedronate, and the remaining 19.3% i.v. zoledronic acid. All patients were prescribed calcium and vitamin D at discharge (a single daily dose of 2,500 mg of calcium carbonate and 880 UI of colecalciferol).

Although it did not form a part of the direct objective of this study, we recorded the percentage adherence to treatment at 6 months from discharge by means of a telephone survey of the patients or close family, obtaining the following results: 40% of patients had abandoned the calcium and vitamin D

and 10% the oral bisphosphonate. Of those who did not abandon the treatment, 56.10% and 59.74% of the patients who had taken calcium and vitamin D and bisphosphonates respectively took it correctly (optimum compliance considered to be when at least 75% of the recommended dose was taken). Logically, the compliance of the patients treated with endovenous bisphosphonates on admission was 100%.

## Discussion

It is well known that after suffering a hip fracture there is a probability of between 14% and 20% of suffering another contralateral hip fracture[5,8], a history of fragility fractures being the most significant isolated clinical risk factor for the appearance of new fractures. It is also known that a patient who has suffered a fragility fracture of the femur has a fourfold greater risk of having a fracture in another location in the following three years. In addition, one of the few studies specifically designed to evaluate the risk of hip fracture among patients having suffered a previous hip fracture, showed that almost 15% of the 481 subjects suffered a second fracture[9]. While only 1% of the subjects would suffer a second hip fracture in the following 6 months, this figure increases to 8% in the first 5 years, and even to 12-15% in the first 10 years of follow up. In our sphere, the AFOE (Acta de Fracturas Osteoporóticas en España - Record of Osteoporotic Fractures in Spain, 2003)[3] study, carried out using data from 77 hospitals from across the whole country uses hip fractures recorded in each centre in the year 2002 and fractures of the hip, shoulder and wrist seen in the month of May 2003, contains very interesting data on this matter. It is not only that the number of fractures registered in the year 2002 was much higher than expected, but also that a third of those patients with hip fractures registered in May 2003 had suffered a previous fracture, 9.4% in the hip, 5.7% in the contralateral hip and 5.5% in the spine. 5.8% of the total number had suffered more than one fracture previously. However, only 23.7% of the patients with hip fracture received or had received any type of drug treatment for osteoporosis, and 60% of those, only calcium, with or without vitamin D.

Therefore, in spite of the strong scientific evidence relating osteoporosis with fracture and previous history of fragility fracture with a higher probability of new fractures, few patients with fragility fractures receive a complete evaluation of their osteoporosis. The directives of the National Foundation for the Study of Osteoporosis (NOF) were updated in 2008, and recommend that clinicians consider the initiation of treatment for osteoporosis in those patients who have suffered a hip or vertebral fracture[1]. However, various studies show a rate of prescription for treatment of osteoporosis in those patients which is uniformly low, between 11% and 53% (an average of 36%)[2,10]. In our series we observed a strong increase in the prescription of bisphosphonates on discharge: 94.6% of patients were prescribed bisphosphonate, in 80.7% of cases this was risedronate. In 100%

Figure 1. Intake of milk products in the patients studied

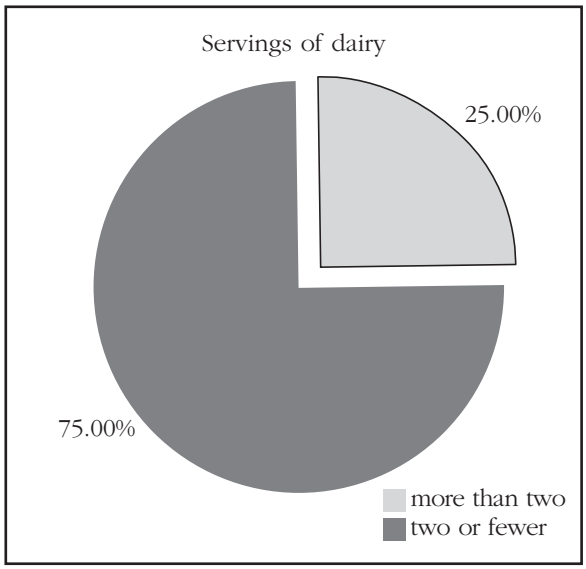


Figure 2. Levels of vitamin D (deficit if <30 ng/ml)

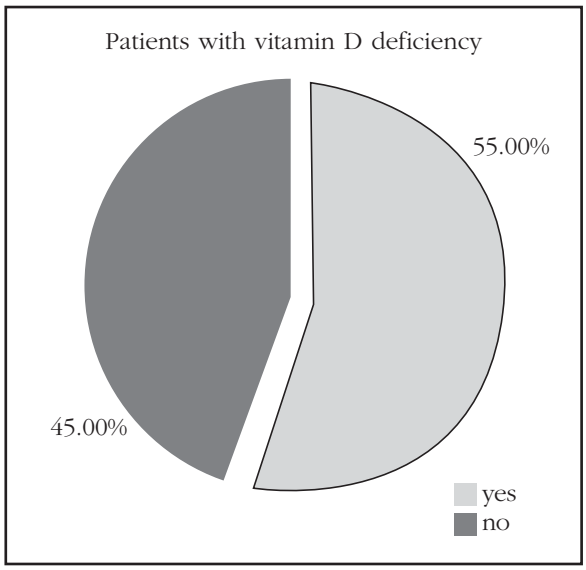


Figure 3. Bone mineral density (BMD) at admission

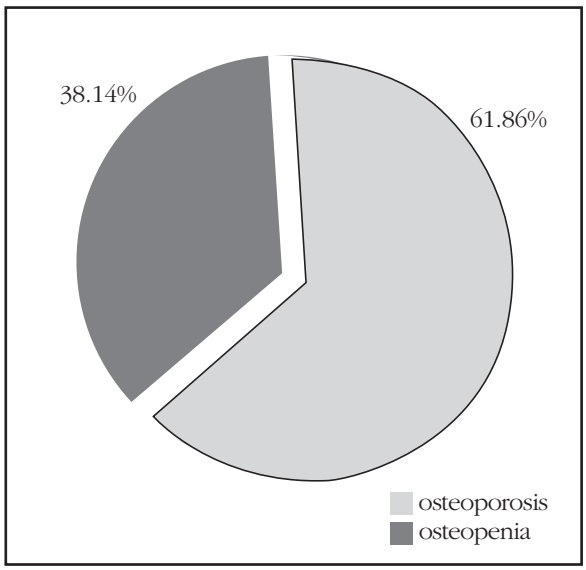

Table 3. Comparison of prescriptions on discharge from 2006 to 2010

| Year | Hip fracture in women | Treatment at discharge bisphosphonates + Ca/vit D |
|---|---|---|
| 2006 | 100 | 2 |
| 2007 | 110 | 8 |
| 2008 | 62 | 58 |
| 2009 | 69 | 66 |
| 2010 | 79 | 75 |
| Our series | 100 | 94 |

of our cases calcium and vitamin D were prescribed on discharge (a significant increase when compared with the 10% who were taking them prior to admission), for which we carried out a comparison of prescriptions in our centre in the years 2006 to 2010 (Table 3).

The prescription rate for treatments for osteoporosis for these patients on discharge varied according to the prescribing service, with the internal medicine service having the highest rate (58%), as against the lowest which was orthopaedic surgery (12%). A study showed that the probability of being prescribed this treatment in internal medicine is 8.33 times higher than in an orthopaedic surgery service[10]. And, specifically in the case of hip fractures, a shocking result that in only 1-9% of cases was treatment initiated for osteoporosis, with calcium with vitamin D the being the treatment most prescribed, and on rare occasions, bisphosphonates[11]. The role of internist includes not only the evaluation, assessment and stabilising of patients before surgery, but also the management and prevention of post-operative complications. This is reflected in their own MIR training plan, which literally states that *"the internist, as hospital generalist, should attend to the majority of medical problems that arise, either as consultant or as physician as part of multidisciplinary teams, thus contributing to the comprehensive care of patients admitted for surgery …".* The contribution of the internist within a multidisciplinary team has been studied in our field, notable being the article of Vidán et al.[12], which deals with the first randomised clinical trial carried out in our country on multidisciplinary geriatric intervention vs normal management in a group of patients over 65 years of age with hip fractures. The duration of stay, analysed as a primary objective, demonstrates a reduction of up to 2 days, and morbimortality and functional capability, analysed as a secondary objectives, showed a lower risk of death and complications, as well as a higher functional capacity after 3 months of follow up.

The benefits have been so notable that the role of a medical internist integrated into the traumatology service has been established in many tertiary level hospitals in European countries, resulting in a reduction in stay (total and postsurgical) of patients not receiving intervention due to medical complications, in mortality, in referrals and in calls on other medical services, and finally, achieving a saving of 60,000 euros a month for the reduction in stay alone[13].

In our centre, a tertiary hospital with 600 beds and a catchment area of 600,000 residents, thanks to the collaboration between the traumatology, orthopaedic and internal medicine services, since 2008 we have been able to count on an internist attached to our hospital departments dedicated to perioperative management of patients with osteoporotic hip fracture in the light of the accompanying high comorbidity in this group of trauma patients. This collaboration is already reflected in a significant reduction in perioperative complications in these patients, as well as in the rate of prescription of bisphosphonates and calcium with vitamin D on discharge.

In patients with osteoporotic hip fracture, the main role of the orthopaedic surgeon is to treat the fracture surgically, once they are in appropriate medical condition to withstand the aggression of surgical intervention. As the recommendations of GEIOS (Grupo de Especialistas en Osteoporosis – Osteoporosis Specialists Group) of SECOT (Sociedad Nacional de Cirugía Orthoédica y Traumatología - National Society of Orthopaedic Surgery and Traumatology) reflect[14], the fundamental objective of osteoporosis treatment is the avoidance of fragility fractures. Once these have occurred, we can then speak of the essential role of the orthopaedic surgeon in identifying this fracture as osteoporotic, and the prevention of the appearance of new fractures. For this, the following steps should be carried out:

1. Ensure the proper intake of calcium and vitamin D, as well as initiating treatment with antiresorptives, ideally bisphosphonates, for at least 2-3 weeks after the fracture being fixed.
2. Ensure early functional rehabilitation.
3. Introduce educative measures to the patient and their family, as well as enabling effective communication with primary care and social services, if required.
4. Insist on the implementation of all measures aimed at preventing new falls.

After the surgical intervention on the patient the second role the orthopaedic surgeon needs to take would be to implement a series of measures to reduce the morbidity and mortality of these patients. With this aim, in our centre we have designed the so-called discharge checklist, in the form of a clinical pathway from the admission of the patient until discharge, with special emphasis on medical treatment for osteoporosis if this had not yet been initiated, and on providing information for the patient and their family regarding the necessity of continuing this treatment in order to

avoid future fracture events. Following these steps will result not only in proper treatment but also continued care after discharge.

Participating in the implementation of this checklist are the traumatologist, the internist and the family doctor, who, after meeting with the family, is responsible for ensuring that good family support is in place for the patient with hip fracture prior to their discharge, and making contact with the social worker from our centre if this family support is not available.

With respect to pharmaceutical measures, the maintenance of optimum levels of calcium and vitamin D should be the basis of all antiosteoporotic treatment. However, the fact that the increase in bone turnover stimulated by the repair of the fracture and remodelling causes an increase in metabolism, and in the need for calcium and vitamin D, should be taken into account, as well as the fact that the elderly population which suffers hip fracture has a higher risk of having suboptimum levels of these elements, due essentially to lower exposure to sunlight, malabsorption, changes in the diet, etc. In addition, a meta-analysis carried out in recent years has shown the benefits of providing vitamin D as a secondary prevention strategy for fractures[15], by reducing the risk of falls and the risk of non-vertebral fractures.

On the other hand, the bisphosphonates constitute the treatment of choice at discharge, and over the long term, in patients who have suffered an osteoporotic hip fracture. Alendronate, risedronate, ibandronate and zoledronic acid have shown their efficacy in reducing the risk of osteoporotic fracture postmenopausal women in a number of well designed clinical trials[3]. Various studies with alendronate and zoledronate have also demonstrated a reduction in the rate of hip fractures. Morin et al. were the first to demonstrate how therapy with antiresorptive agents was capable of reducing the risk of new fractures occurring in patients who had suffered hip fractures[16]. This reduction in risk of new fractures may already be detected after the first 6 months of treatment[17]. Furthermore, treatment with oral bisphosphonates reduces global mortality by 8% per month of treatment, or approximately 60% for each year of treatment, as has been recently demonstrated[18]. Daily oral administration is effective; however, its compliance is low. Weekly or monthly administration appears to improve adherence to treatment, which, however, continues to be at suboptimum levels.

Once therapy is assessed and initiated, we consider that hospitalization due to hip fracture is a real clinical opportunity for the multidisciplinary hip fracture team, as studies which relate this early start to treatment on discharge with bisphosphonates with higher rates of compliance, demonstrate[8]. In addition, the orthopaedic surgeon also plays a crucial role, since it appears that compliance in treatment with bisphosphonates prescribed by the orthopaedist on discharge is higher than when it is prescribed by a primary care doctor: according to a randomised study of 162 patients with hip fracture followed up over 6 months, it was observed that 58% of patients treated by the orthopaedist maintained their treatment as against 29% of those whose treatment has been prescribed by a primary care doctor[19].

In conclusion, collaboration between services greatly improves the care given to the group of patients admitted with hip fracture to traumatology services. Thus we have developed a checklist on the clinical pathway model, with excellent initial results: thanks to the conscientiousness of medical staff, the percentage of patients treated with medication for osteoporosis increased significantly on discharge (Ca/vitamin D: from 10% to 100%; bisphosphonates: from 2% to 96%). We did not have more than 6 months of follow up data available, but it is our intention to study adherence to treatment and the incidence of new hip fractures after a year and two years from the start of this study.

**Note:** This study shows some of of the results developed in the doctoral thesis of the first signatory 20.

## Bibliography


1. National Osteoporosis Foundation (NOF). Clinician´s Guide to Prevention and Treatment of Osteoporosis. Washington DC; National Osteoporosis Foundation, 2008.
2. Ekman EF. The role of the orthopaedic surgeon in minimizing mortality and morbidity associated with fragility fractures. J Am Acad Orthop Surg 2010;18:278-85.
3. Herrera A y cols. Acta de Fracturas Osteoporóticas en España (AFOE). Grupo de Estudio e investigación en Osteoporosis SECOT. Medical & Marketing Communications. Madrid; 2003.
4. Lyles KW, Colon-Emeric CS, Magaziner JS. HORIZON Recurrent Fracture Trial. Zoledronic acid and clinical fractures and mortality after hip fracture. N Engl J Med 2007;357:1799-809.
5. Von Friesendorff M, Besjakov J, Akesson K. Long-term survival and fracture risk after hip fracture: A 22-year follow up in women. J Bone Miner Res 2008;23:1832-41.
6. Díaz-Curiel M, Carrasco de la Peña JL, Honorato-Pérez J, Pérez-Cano R, Rapado A, Ruiz-Martínez I. Study of bone mineral density in lumbar spine and femoral neck in Spanish population. Osteoporos Int 1997;7:59-64.
7. The role of calcium in peri- and postmenopausal women: 2006 position statement of the North American Menopause Society. Menopause 2006;13:862-77.
8. Chrischilles E, Butter CD, Davis CS, Wallace RB. A model of lifetime osteoporosis impact. Arch Inter Med 1991;151:2026-32.
9. Berry SD, Samelson EJ, Hannan MT, McLean RR, Mei Lu MS, Cupples LA, et al. Second hip fracture in older men and women: the Framingham study. Arch Intern Med 2007;167:1971-6.
10. Gregory PC, Lam D, Howell P. Osteoporosis treatment following hip fractures: How rates vary by Service. South Med J 2010;103:977-81.
11. Feldstein A, Elmer PJ, Orwoll E, Herson M, Hillier T. Bone mineral density measurement and treatment for osteoporosis in older individuals with fractures: a gap in evidence-based practice guideline implementation. Arch Intern Med 2003;163:2165-72.
12. Vidán M, Serra JA, Moreno C. Efficacy of a comprehensive geriatric intervention in older patients hospitalized for hip fracture: a randomized, controlled trial. J Am Geriatr Soc 2005;53:1476-82.

13. Montero M, García M, Carpintero P. Malnutrition as a prognostic factor in elderly patients with hip fractures. Med Clin (Barc) 2007;128:721-5.
14. Herrera A, Cáceres E, Caeiro JR, Canales V, Curto JM, Fernández N, et al. (Grupo de expertos en osteoporosis de la SECOT). Recomendaciones de manejo clínico del paciente mayor de 50 años con fractura osteoporótica. Rev Esp Enf Metab Óseas 2003;12:125-8.
15. Bischoff-Ferrari HA, Willett WC, Wong JB, Giovannucci E, Dietrich T, Dawson-Hughes B. Fracture prevention with vitamin D supplementation: a metaanalysis of randomized controlled trials. JAMA 2005;293:2257-64.
16. Morin S, Rahme E, Behlouli H, Tenenhouse A, Goltzman D, Pilote L. Effectiveness of antiresorptive agents in the prevention of recurrent hip fractures. Osteoporos Int 2007;18:1625-32.
17. Gallagher AM, Rietbrock S, Olson M, van Staa TP. Fracture outcomes related to persistence and compliance with oral biphosphonates. J Bone Miner Res 2008;23:1569-75.
18. Beaupre L, Morrish DW, Hanley DA. Oral biphosphonates are associated with reduced mortality after hip fracture. Osteoporos Int 2011;22:983-91.
19. Miki RA. Orthopaedic management improves the rate of early osteoporosis treatment after hip fracture. J Bone Joint Surg (Am) 2008;90:2346-53.
20. Herrera Pérez M. Fiabilidad de las escalas de predicción del riesgo de osteoporosis y fractura osteoporótica e implementación de medidas de profilaxis secundaria en mujeres postmenopaúsicas hospitalizadas por fractura de cadera. Tesis Doctoral, Universidad de La Laguna, 2011.