Genij Ortopedii. 2023;29(1)20-26.

Original article

https://doi.org/10.18019/1028-4427-2023-29-1-20-26

Osteoporosis from the perspective of specialized trauma and orthopaedic treatment of low-energy fractures of the proximal femur

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Abstract

Introduction The low detection rate of osteoporosis and the lack of treatment in the elderly can contribute to a higher rate of low-energy fractures, poor results of surgical treatment and mortality. **The purpose** of the work was to evaluate the frequency of detection and treatment of osteoporosis before the fracture and during specialized trauma and orthopaedic care provided for a low-energy fracture of the proximal femur in the elderly. **Material and methods** A retrospective analysis of 209 medical histories of individuals aged 60 years and older who received treatment for a low-energy fracture of the proximal femur in 2 randomly selected trauma departments and a telephone survey of the patients performed at 3-8 months were produced. Availability of the diagnosed osteoporosis and the treatment before and during fracture repair were identified. **Results** The diagnosed osteoporosis was established in 5.2 % prior to fracture occurrence and in 16.7 % after the fracture occurrence. In both cases, the condition was treated with colcalciferol, calcium and pathogenetic therapy used in some cases. **Discussion** Diagnosis and treatment of osteoporosis in the elderly remained low before a low-energy fracture of the proximal femur and during trauma and orthopaedic treatment. **Conclusion** The initiation and treatment of osteoporosis during the trauma and orthopaedic management of a low-energy fracture should be considered as a component of the high-quality specialized care.

Keywords: low-energy fracture, osteoporosis, treatment of osteoporosis in low-energy fracture

For citation: Solomiannik IA, Rodionova SS, Torgashin AN, Seropolov PS, Mironov SP, Gubin AV. Osteoporosis from the perspective of specialized trauma and orthopaedic treatment of low-energy fractures of the proximal femur. *Genij Ortopedii*. 2023;29(1):20-26. doi: 10.18019/1028-4427-2023-29-1-20-26

INTRODUCTION

About 30-40 % of patients hospitalized for fractures of various localization are individuals aged 60 years and older. A significant proportion of them have osteoporosis which reduces bone strength and is the cause of low-energy fractures [1]. Osteoporosis was identified as a nosological entity by Fuller Albright in 1940 [2], and by now the disease is known to a wide range of doctors of various specialties. An algorithm for early detection of the disease has been developed, methods for quantifying the severity of bone mass deficiency have been introduced into clinical practice, there are drugs for pathogenetic therapy (correction of impaired bone tissue remodeling), however, the pathology is commonly diagnosed and considered by the patient and physician only after a low-energy fracture has occurred [3]. WHO launched a 2000-2010 campaign to focus on increasing community and health professional awareness and advocating to government to reduce the impact of the osteoporosis nationally. Early detection and treatment of the disease were deemed to reduce the incidence of fractures and fractures of the proximal femur by 25 %. However, there was no decrease in the incidence of bone fractures and in recent years there has been a trend towards an increased rate of low-energy fractures, including a fracture of the proximal femur being one of the most serious complications of osteoporosis [3, 4]. The in-hospital mortality with a hip fracture reaches 10 % [5]. Mortality ranges between 20 % and 36 % [6, 7] during the first year after fracture, and no downward trend is observed. Between 1981 and 2012, the average one-year mortality rate was reported to be 24 % in the 1980^{s}, 23 % in the 1990^{s}, and 21 % after 1999 ($p = 0.7$) [8]. The frequency of reoperations during these time intervals remained the same. The change in the philosophy of surgical intervention did not affect mortality in fractures of the femoral neck: comparison of the mortality rates in the era of osteosynthesis (before 1990) and the era of total joint replacement (after 2000) showed identical results (~ 20 %) [9].

One of the reasons for maintaining the "stable" mortality rate and the continuing increase in the number of fractures may include an increase in life expectancy and the population of elderly and senile people [10], which is also typical for Russia [11]. Age as a risk factor for fracture can be considered only in connection with other variables including concomitant diseases and physical status, physical and functional health or biological aging [12]. This point of view is supported by the fact that the mortality rate is higher in elderly patients with low-energy femoral neck fractures not

only in comparison with the mortality of the general population, but also in comparison with mortality in the corresponding age groups [13]. Hence the lack of treatment of osteoporosis as a pathology that aggravates functional and biological aging can be considered not only as a significant factor in the increased rate of the proximal femur fractures including repeated fractures, but also as a cause of high mortality after a fracture and complications associated with surgical treatment of pathological fractures. The probable lack of treatment of osteoporosis is not obvious before a fracture occurs, given that the rubricator of the Russian Ministry of Health presented "Osteoporosis" clinical recommendations in 2018 with clear criteria for the diagnosis and treatment of osteoporosis aimed at preventing fractures, and clinical recommendations "Pathological fractures complicating the course of osteoporosis", dedicated to the treatment of osteoporosis after a fracture. In addition to that, over the past 30 years, various professional communities (rheumatologists, endocrinologists, trauma surgeons, general practitioners) have been holding numerous meetings, seminars, training schools on the diagnosis and treatment of osteoporosis, including those complicated by pathological fractures which implies awareness of doctors about pathology and the need for the treatment. Based on the above information, the issue of treating osteoporosis before a fracture and, moreover, within the framework of specialized medical trauma and orthopedic care requires clarification. **Hypothesis** The detection and treatment of osteoporosis before a low-energy fracture of the proximal femur and during specialized trauma and orthopaedic care after a fracture in elderly patients remain at a low level.

The purpose of the work was to evaluate the frequency of detection and treatment of osteoporosis before the fracture and during specialized trauma and orthopaedic care provided for a low-energy fracture of the proximal femur in the elderly.

MATERIAL AND METHODS

Case histories of patients aged 60 and older who were admitted to 2 trauma departments in 2019 (Krasnodar Region (n = 117) and Moscow Region (n = 82)) were reviewed to obtain information about osteoporosis diagnosed and treated before a fracture in individuals with a low-energy fracture of the proximal femur or osteoporosis therapy administered as part of trauma and orthopaedic care. Regions were randomly selected. Diagnosis of osteoporosis was specified in the sections "diagnosis at admission", "diagnosis at discharge", "concomitant diagnosis", in the text of the medical history, in the discharge summary, recommendations at discharge using the medical history. A phone call was arranged to patients at 3 to 8 months after discharge from the hospital to clarify the presence or absence of the diagnosis of "osteoporosis" before the fracture. Patients were asked about the presence of a diagnosis of osteoporosis, when this diagnosis was made ("before the fracture" or "after the fracture"), what kind of treatment the patients had before and after the fracture.

RESULTS

Analysis of 209 case histories of patients with a fracture of the proximal femur treated in 2 trauma hospitals showed the median age of the individuals with a fracture of this localization being 79 years (range, 68-84 years). There were 144 female and 65 male patients. The median age of females was 81 years (73.25-85) and males, 65 years (58.5-81.5). Although a low-energy fracture was noted in all cases there was no information about the presence of a diagnosis of osteoporosis in 203 out of 209 case histories at admission and at discharge. Diagnosis of osteoporosis was indicated only in 6 cases (2.8 %) out of 209. The diagnosis of osteoporosis was confirmed in another 5 patients before the fracture via phone calls (179 out of 209 patients responded). Overall, only 11 (5.3 %) of 209 patients were diagnosed with osteoporosis before the fracture. There was no information about the treatment of osteoporosis before the fracture in the case histories and was only obtained by telephone contact. One patient occasionally received colcalciferol at a dose of 800-1000 IU, 7 individuals received calcium and colcalciferol for at least a year and 1 person regularly received calcium preparations. Antiresorptive therapy was administered for 2 cases and included Denosumab (n = 1) and 5 mg zoledronic acid (n = 1). In both cases, pathogenetic therapy for osteoporosis was initiated at 1 and 3 months before the fracture. Diagnosis of osteoporosis was indicated in 35 (16.7 %) case histories out of 209 at discharge. Treatment recommendations in that time period included calcium and cholecalciferol preparations in 35 (16.7 %) cases with alfacalcidol simultaneously prescribed in 3 (1.4 %) cases, zoledronic acid was added to this combination of drugs in one case and ibandronic acid added in 2 cases. There were no recommendations on the duration of therapy and the need for control (Table 1). The analysis of the case histories of elderly patients with a low-energy fracture of the proximal femur (a fracture was a marker of osteoporosis) revealed a low incidence of detection and treatment of osteoporosis before the fracture and after its surgical treatment.

Table 1

Pre- and post-fracture incidence of osteoporosis and drugs used to treat osteoporosis

Drugs administered	Osteoporosis diagnosed			
	Prior to fracture	After fracture	Not established	Total
Cholecalciferol 800-1000 ME + calcium	9	32	–	209 (100 %)
Cholecalciferol 800-1000 ME/alfacalcidol + calcium + antiresorptive therapy (zoledronic acid, ibandronic acid or Denosumab)	2	3	–	
No treatment performed	–	–	163	
Total	11 (5.3 %)	35 (16.7 %)	163 (78 %)	

Diagnosis and treatment of osteoporosis remain at an extremely low level both before a low-energy fracture of the proximal femur and during specialized trauma and orthopaedic care after a fracture in the elderly. The 3-level organization of medical care in the regions of the Russian Federation [60] provides for patient routing considering the continuity of medical services provided at trauma hospitals of all levels and trauma centers, trauma rooms at polyclinics, trauma departments at the city and district hospitals. The vertical organization of medical care allows initiation of the treatment of osteoporosis as specialized care for low-energy fractures before consolidation or formation of biological stability during arthroplasty. Clinical guidelines "Pathological fractures complicating the course of osteoporosis" include "fracture consolidation achieved" as the criterion for the quality of specialized care and the treatment of osteoporosis provided as part of specialized care for low-energy fractures is presented in a diagram (Fig. 1).

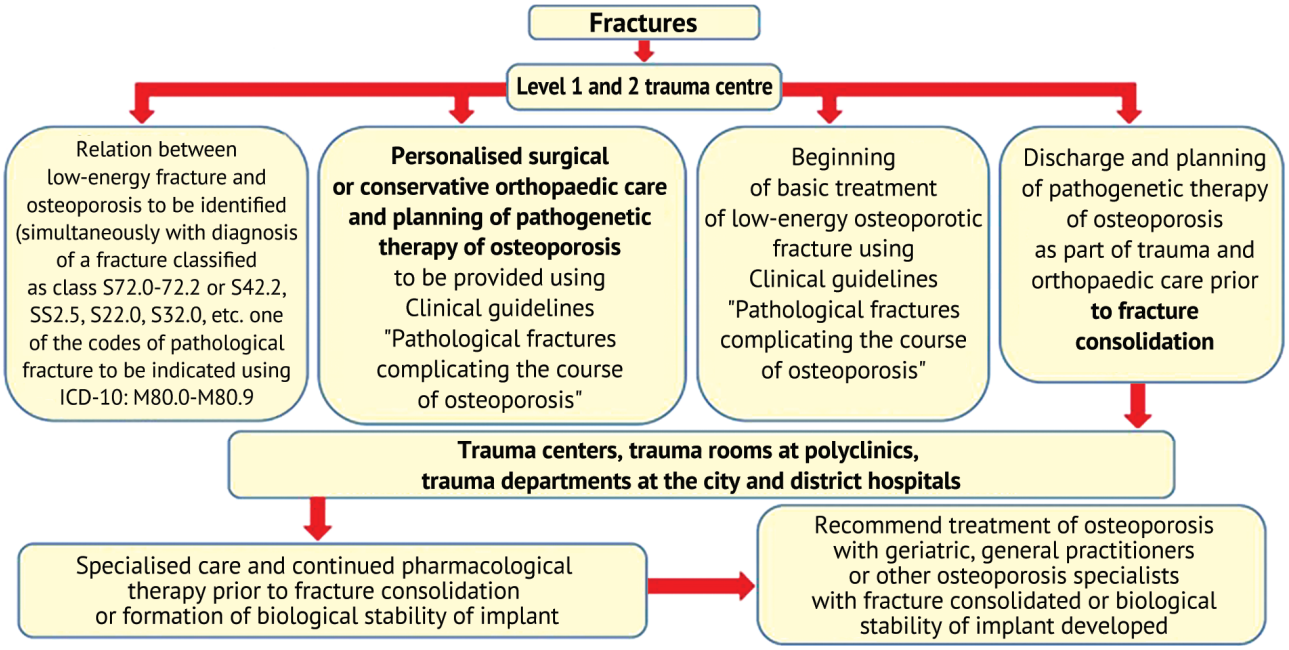

Fig. 1 Initiation and treatment of osteoporosis in patients with low-energy fractures at stages of specialized trauma and orthopaedic care

DISCUSSION

Low prescription of pharmaceuticals for the treatment of osteoporosis in patients with low-energy fractures of the proximal femur, including those after a fracture, revealed in the study, was reported by other authors [14]. A review of 86,202 cases of femoral neck fractures in the United States, Korea, and Spain showed [15] that the use of drugs for the treatment of osteoporosis and prevention of recurrent fractures was extremely low within 3 months after the fracture being administered for 13 %, 39 %, and 25 % of patients, respectively. Prescribing medications was independent of differences in health care systems and reimbursement rates for osteoporosis treatment. Adherence to osteoporosis treatment turned out to be suboptimal: less than 0.70 in the three countries.

Our series showed that pathogenetic therapy for osteoporosis was not administered before the fracture and was extremely rare (in 3 cases only) prescribed as part of trauma and orthopaedic care for a fracture. Findings of randomized trials demonstrated that

treatment of osteoporosis reduced the risk of fracture and maintained the physical activity of patients [16]. This was extremely important, given that only 29 % of survivors of a femoral neck fracture could restore before-the-injury functional level [17, 18]. The fracture of the proximal femur was a "point of no return" to the previous physical and mental state for the majority of elder patients. Decreased functional activity relative to before-the-fracture period along with the loss of social independence led to deterioration in the quality of life and increased mortality rate during the first year of injury [19, 20]. These complications were associated not so much with age as with the aggravation of biological aging due to the lack of treatment of osteoporosis including before-the-fracture time [12].

The low level of diagnosis and treatment of osteoporosis in individuals with low-energy fractures of the proximal femur observed before and after the fracture was likely to reflect the real picture. The fact that patients who sustained a low-energy fracture due to osteoporosis were not diagnosed and received no medication treatment was confirmed by official statistics. According to the federal statistical data, the number of osteoporotic cases in people older than working age was 109,548 in 2017 and 124,439 in 2019 in Russia [21]. Of these, 13,636 were first diagnosed with osteoporosis in 2017 and 15,250 in 2019, which accounted for 0.07-0.08 % of the total number of diseases first diagnosed life in this age group [21]. There were 54,974 cases of femoral fractures (S72) in this age group in 2017, and 59,741 cases in 2019 (an increase of 9 %) [21] and no indication of the ICD-10 code "M80.1-M80.9" suggested that those were low-energy fractures due to osteoporosis. Our assumption is justified given the previously published data [22] about 14 million people in Russia suffering from osteoporosis. This statistical discrepancy indicates the lack of reliable data on the number of patients with osteoporosis and the prevalence of low-energy fractures of the proximal femur. The role of osteoporosis diagnosis and the treatment was earlier described in providing medical care to a patient with a low-energy fracture in the field of "trauma and orthopaedics". The bone compromised by osteoporosis due to quantitative and structural changes [23] can cause problems during surgical intervention resulting in difficulties of reliable bone fixation [24]. A correlation between decreased bone mineral density (BMD) and the risk of impaired fracture fixation has been reported in experimental studies [25]. The thickness of the cortical bone and the density of the cancellous bone substance provide approximately 98 % of the dispersion of the ultimate load on the screws under the forces of axial traction mode or “bending” [26]. In trauma and orthopaedic practice, neglected osteoporosis can cause instability, migration or fracture of a metal construct with resultant nonunion [27, 28, 29]. It was found [25] to be practical to measure BMD preoperatively in low-energy fractures to identify more appropriate fixation for osteoporotic patients. However, according to the European [30, 31] and Russian clinical guidelines [32, 33], DEXA is optional for individuals aged 50 and over with fractures that are markers of osteoporosis (low-energy fracture of the proximal femur, proximal humerus, distal radius, and vertebral bodies). The method can be effective in detecting osteoporosis in low-energy fractures in males under 50 years of age and in women before menopause (Z-test is used) [34].

With osteoporosis detected preoperative planning includes considerations of injury type, the number of fragments, extent of bone displacement and the quality of bone tissue [28]. Due to, The use of minimally invasive constructs can be advocated in the deficiency of cortical and cancellous bone inherent in osteoporosis [35]. Surgical intervention in these cases is to be performed by highly qualified orthopaedic and trauma surgeons appropriate surgical expertise in conditions of poor quality of bone tissue [27, 36]. The complex surgical treatment of osteoporotic patients is observed not only in marker fractures in individuals aged 50 and over. There are reports of problematic fixation of fractures of other bones that occurred in steoporotic patients, the bones that form the ankle joint [37]. Diagnosis of osteoporosis determines the choice of treatment method in some localizations of low-energy fractures (radius and humerus): closed reduction or surgical intervention [38, 39, 40]. Diagnosis of osteoporosis during preoperative planning is considered as an important component of trauma and orthopaedic care [41].

The initially impaired intensity (acceleration or deceleration) of the remodeling mechanisms leads to a transient or permanent violation of the bone physiology in osteoporotic patients. This accelerates the loss of bone tissue adjacent to the implant in the early postoperative period, delays the callosity and can cause nonunion, AVN of the femoral head, aseptic instability of the implant and even a fracture [42-48]. Impaired balance of the strength of the cortical and cancellous bone, insufficient density of contacting loaded surfaces due to low BMD, and the formation of periprosthetic osteolytic zones aggravate the disorders [25]. Normalization of calcium homeostasis, vitamin D metabolism, and remodeling mechanisms in the early postoperative period in osteoporotic patients is important for consolidation like the stable osteosynthesis [49-51]. The basic therapy of a low-energy fracture in osteoporosis including calcium preparations, alfacalcidol or colecalciferol reduces period of consolidation

of a pathological fracture, the duration of hospitalization and the rehabilitation period [33, 52, 53]. Calcium and cholecalciferol preparations administered in the early postoperative period are regarded as prevention of new fractures [54]. Neglect of this recommendation increases the risk of subsequent fracture by more than 2 times and increases the mortality rate [55].

Pathogenetic therapy is essential for osteoporosis complicated by a low-energy fracture [16]. Antiresorptive drugs have the greatest evidence base [56, 57]. Although the beginning for the use has not been definitively indicated, there is evidence [58] that the appointment of antiresorptive therapy in the first three months after a fracture of the proximal femur significantly reduces the risk of re-fracture compared with the later administration (RR = 1.93, 95 % CI 1,292.89). These data confirm that the initiation and control of pathogenetic therapy of osteoporosis as part of trauma and orthopaedic care provided for low-energy fractures of the proximal femur in older people are aimed primarily at improving the effectiveness of fracture repair reducing complications such as nonunions, aseptic instability and mortality. Diagnosis of osteoporosis during preoperative planning in a low-energy fracture allows for isolation of this cohort of patients from the patients of any age with femoral fractures, which is necessary for reliable statistical analysis and substantiation of sufficient funding of specialized medical care.

CONCLUSION

The insufficient level of diagnosis and treatment of osteoporosis is one of the causes of low-energy fractures and complications in the surgical treatment. This sets the task for the trauma community to improve the quality of specialized medical care that is categorized as predictive, preventive and personalized [59]. Based on the assumption, pathogenetic therapy of osteoporosis in low-energy fracture should be considered as a component of high-quality trauma and orthopaedic care, which is planned with osteoporosis that caused the fracture diagnosed. Although the organizational and economic emphasis of trauma and orthopaedic care for low-energy fractures in the elderly suggests the use of expensive short-term high-tech treatment without long-term hospitalization and inpatient rehabilitation [60], this problem can be solved with the help of a 3-level system of specialized care. The vertical organization of the system, routing and control of the treatment with the succession of the work of trauma hospitals at all levels and trauma centers, trauma rooms at polyclinics of city and district hospitals allows for follow-up of the patient until the fracture is completely consolidated or the biological stability of endoprosthesis formed. High-quality specialized trauma and orthopaedic care suggests that once the fracture is repaired, the patient can continue the treatment of osteoporosis under the supervision of a gerontologist, general practitioner or other specialist who deals with this problem, in order to prevent re-fractures.

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The article was submitted 05.05.2022; approved after reviewing 16.06.2022; accepted for publication 16.12.2022.

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Conflict of interests *The authors received no funding for this work and declare no conflicts of interest.*