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Distal radius fracture: Cinderella of the Osteoporotic Fractures

Anna Litwic[1], **Lekarz, David Warwick**[2] **and Elaine Dennison**[1*]

[1]*MRC Lifecourse Epidemiology Unit (University of Southampton), Southampton General Hospital, Southampton SO16 6YD, UK*

[2]*Orthopaedic Department, University Hospital Southampton, Southampton SO16 6UY, UK*

[*]**Corresponding author:** Elaine Dennison, MB BChir MA MSc PhD FRCP, Professor of Musculoskeletal Epidemiology and Honorary Consultant in Rheumatology, MRC Lifecourse Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton SO16 6YD, UK, Tel: +44 (0) 23 8077 7624; Fax: +44 (0) 23 8070 4021; E-mail: emd@mrc.soton.ac.uk

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Abstract

Osteoporosis is a systemic disorder characterized by low bone mass and microarchitectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture. It has a significant impact on public health through the increased morbidity, mortality, and economic costs associated with fractures. The most common fracture sites are hip, spine and distal forearm. Among the different types of, the clinical and economic impact of hip and vertebral fractures have received most attention. There has been growing evidence, however, to suggest that the personal and public burden of fractures at other sites, including distal radius fracture, may have been under-recognized. This review will focus on the consequences of the Cinderella of the osteoporotic fractures – the distal radius fracture.

Keywords: Osteoporosis; Bone fragility; Fragility fractures

Introduction

Osteoporosis is a systemic disorder characterized by low bone mass and microarchitectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture [1]. It has a significant impact on public health through the increased morbidity, mortality, and economic costs associated with fractures. The most common fracture sites are hip, spine and distal forearm. In 2000, an estimated 9 million osteoporotic fractures occurred: 1.6 million at the hip, 1.7 million at the forearm and 1.4 million clinical vertebral fractures. Epidemiological studies from North America have estimated the lifetime risk of common fragility fractures to be 17.5% for hip fracture, 15.6% for clinically diagnosed vertebral fracture and 16 % for distal forearm fracture among white women aged 50 years [2]. Corresponding risks among men are 6%, 5% and 2.5%. A study of British fracture occurrence indicates a similar population risk in the United Kingdom. It indicates that one in two women 50 years old will have an osteoporotic fracture in their remaining lifetime; the figure for men is one in five [3]. The combined annual costs of all osteoporotic fractures have been estimated to be 20 billion dollars in the United States and 30 billion euros in the European Union [4].

Among the different types of fragility fractures, the clinical and economic impact of hip and vertebral fractures have received most attention. There has been growing evidence, however, to suggest that the personal and public burden of fractures at other sites, including distal radius fracture, may have been under-recognized [3,5]. This review will focus on the consequences of the Cinderella of the osteoporotic fractures – the distal radius fracture.

Prevalence and Incidence of Distal Radius Fracture

Distal radius fractures (DRF) are the most common type of fracture among adults, with more than 640,000 cases reported during 2001 in the United States alone [6,7]. DRF fractures show a pattern of occurrence which differs from that of hip and vertebral fractures. Most DRF fractures occur in women. There is an increase in incidence in white women between the ages of 45 and 60 years, followed by a plateau. The plateau with age in women may be explained by mode of falls, which changes with age. Later in life a woman is more likely to fall onto a hip than an outstretched hand as the speed and strength of extending the arm to protect other parts of the body during falls decreases with age.

Geographical location	Women	Men
Oslo, Norway	767	202
Malmö, Sweden	732	178
Stockholm, Sweden	637	145
Rochester, MN, USA	410	85
Trent, UK	405	97
Yugoslavia High calcium area Low calcium area	228 196	95 110
Oxford-Dundee, UK	309	73
Tottori, Japan	149	59
Singapore	59	63
Adebajo, Nigeria	3	4

Table 1: Age-adjusted incidence (per 100 000 per year) of DRF in different populations of people aged 35 years or older (ref 4)

Interestingly, significant variation in DRF fracture rates among women from different nations has been observed. Highest rates are

observed in Caucasian women, with lowest rates observed in African women and intermediate rates among Asian women [4] (Table 1). These differences are likely to represent a combination of genetic and environmental differences. In all groups, an increase in absolute fracture numbers is anticipated due to demographic changes.

Data from the General Practice Research Database show that in a woman's lifetime risk of DRF fracture at 50 years old is 16.6%, and it falls to 10.4% at 70 years old. The incidence in men is low and does not increase significantly with age (lifetime risk is 2.9% at age 50 years and 1.4% at age 70 years) [8] (Table2).

Forearm fracture	Men	Women	Risk Ratio
At 50 years old	2.9	16.6	5.7
At 60 years old	2.0	14.0	7.0
At 70 years old	1.4	10.4	7.4
At 80 years old	1.1	6.9	5.8

Table 2: Remaining lifetime risk of DRF fracture (%) in men and women at 50 and 70 years of age Cited from ref 8

Risk Factors

Several factors associated with an increased risk of low-energy DRF have been identified e.g. gender, vitamin D deficiency, seasonal variations, environmental conditions, medication and osteoporosis [9-12]. Some factors such as low bone mineral density (BMD), age and history of previous low trauma fracture are strongly predictive of all types of fracture. Other risk factors are different in DRF than in vertebral and hip fractures [13-16].

Distal radius fractures often occur as a result of a fall in women with low bone mineral density who are relatively healthy and active. In a prospective cohort study with 2578 participants, those with a moderately impaired walking ability were found to have a higher risk of hip fracture (RR=1.8, 95% CI 1.2–2.7) but a lower risk of DRF (RR=0.4, 95% CI 0.2–0.8) compared with normal walking ability, adjusted for age and gender, Also going outdoors less than once a week, compared with three times or more was associated with lower risk of distal forearm fractures only (RR=0.3, 95% CI 0.1–0.9)[14]. Similarly, in the Study of Osteoporotic Fractures women who had sustained DRF had significantly better functional status at baseline, a higher gait speed (1.04 v 1.09 m/s, P<0.001) greater hip abduction strength and were able to stand up from a chair more quickly (5.498 v 5.776 s, P=0.006 , compared with their counterparts who did not have wrist fractures [15].

Environmental conditions may contribute to an increased risk of DRF in elderly women. The prevalence of those fractures which occur indoors, is stable throughout the seasons [17], whereas outdoor fractures have been shown to occur more frequent in the winter months [17-19] especially, in snowy and icy conditions [20]. Reports suggest a higher incidence of fractures among city dwellers compared with rural populations. In a Norwegian study the odds ratio for men sustaining a forearm fracture living in a city areas was 1.38 compared with rural areas [21]. The findings for women were similar. Different lifestyles in urban populations compared with rural populations, might be a reason for this difference.

Health Impact of Distal Radius Fracture

Osteoporotic fractures account for 0.83% of the global burden of non-communicable disease worldwide and 1.75% in Europe where osteoporotic fractures account for more disability-adjusted life years (DALYs) than many other chronic non-communicable diseases [3]. Although the functional impairment attributed to vertebral fractures and hip fractures has been well documented, the consequences of wrist fractures on functional decline have been less well studied. However, available data suggest that the osteoporotic fractures at sites other than hip and spine (non-hip, non-vertebral [NHNV] fractures) may result in considerable morbidity and impact on health-related quality of life (HRQL) [11,15,22].

In a recently published prospective, multinational, observational cohort study of women over 55 years problems with self-care, mobility, activities, and pain/discomfort were measured at baseline and after incident fracture [22]. Minor NHNV fractures, of which DRF fracture was reported to be the most common, were associated with increases in problems with mobility, self-care, activities and pain/discomfort by 3%, 5%, 3% and 4% respectively. The proportion of women who reported a decrease in general health status between the baseline and 1-year surveys was 21% in this fracture group. In this study incident DRF fractures had no effect on SF36 physical function or vitality. With regards to functionality, this findings contrast with the results of studies that assessed the effect of DRF in relation to specific tasks involving upper limb function.

In the Study of Osteoporotic Fractures, the occurrence of a DRF increased the odds of having a clinically important functional decline by 48% (odds ratio 1.48, 95% confidence interval 1.04 to 2.12) [15]. Functional decline was defined by worsening ability to prepare meals, perform heavy housekeeping, climb 10 stairs, go shopping and get out of a car. The effect of DRF could be compared with other established risk factors for functional decline such as falls, diabetes and arthritis. Similarly in the study by Gonzalez and colleagues, where measures used were specific for upper-extremity disability, individuals who sustained DRF lost more HRQL and functionality 6 months after the fracture than those without a fracture [23].

DRF also carries an increased risk for subsequent fractures [20, 24, 25]. Data from the Rochester cohort suggest that in women with a DRF fracture, there is a 1.4-fold increase in the risk of a subsequent hip fracture [24]. These findings are consistent with the results of Scandinavian studies [20,25]. There is 1.5-fold increase in hip fractures seen among 2252 Swedish women age 40 years or more with a DRF and a 1.8-fold increase among 1162 Danish women 20 years old or over with a DRF. The corresponding results for men in Rochester and Swedish cohorts are 2.7-fold and 2.3-fold increase in hip fractures respectively. Similarly other types of fractures are reported to be increased among Rochester women and men, with the greatest increase in risk for vertebral fractures. The standardized incidence ratios for fractures other than hip in women range from 1.0 to 5.6 and in men are higher from 2.7 to 10.7.

This is further supported by a recent study from Taiwan, in which 9,986 newly diagnosed DRF cases were identified between 2000 and 2006 as the DRF cohort and 81,227 persons without a history of DRF as the comparison cohort [26]. The subjects were followed up for 1 year after recruitment. In this study, patients with DRF had a much greater risk for subsequent hip fracture within 1 year, compared with the control group (HR=3.45). The risk was the greatest (17 times) in

the first month after the DRF. These findings emphasize the importance of prompt therapeutic action after diagnosis of DRF.

Complex regional pain syndrome post distal radius fracture

While DRFs are traditionally considered less significant than other osteoporotic fractures, they are often associated with a poor outcome, In a review of 565 patients, Cooney et al reported a 31% overall complication rate [27]. A particular problem after DRF is Complex Regional Pain Syndrome (CRPS) otherwise known as reflex sympathetic dystrophy, shoulder-hand syndrome and algodystrophy. CRPS is a syndrome of pain and widespread tenderness, allodynia, vasomotor instability, diffuse swelling and stiffness. In a study by Atkins et al, nine weeks after DRF, of the 60 patients studied, 24 had evidence of vasomotor instability, a recognised association of CRPS [28]. In a separate study, one hundred consecutive patients with displaced DRF were reviewed ten years after the injury. At ten year follow up, 15% of those surviving had an unsatisfactory outcome. Sixty-two percent of those with an unsatisfactory result had objective features of CRPS, compared with only 6% of those with a satisfactory result [29]. In a recent prospective study the incidence of CRPS after DRF treated by closed reduction and cast immobilization was high at 32.2% [30]. These data suggest that CRPS is a significant and relatively common complication of Colles' fracture, that can have a major impact on patients' quality of life.

Mortality

The increased mortality post hip and vertebral fractures have been well recognised and studied. In previous analyses minor fractures were not associated with an increase in mortality [24]. However, data from the Dubbo osteoporosis epidemiology study suggest that all low-trauma fractures are associated with an increased mortality risk for 5 years [31]. In this cohort of 659 non-hip, non-vertebral fractures (NHNV) (74% in women and 26% in men), these fractures contributed to 28% and 31% of all excess deaths in women and men, respectively. The age adjusted standardised mortality ratio was increased in minor fractures (including DRF) (SMRs, 1.42 [95% CI, 1.19-1.70] and 1.33 [95% CI, 0.99-1.80]) for both women and men, respectively. Mortality rates for 5 years after minor fractures were higher than the general population for the age groups above 75 years.

Furthermore, not only does DRF carry an increased risk for subsequent fractures as described above, but also that subsequent fracture was associated with an increased mortality hazard ratio of 1.91 (95% CI, 1.54-2.37) in women and 2.99 (95% CI, 2.11-4.24) in men [31]. Mortality risk following a subsequent fracture then declined but beyond 5 years still remained higher than in the general population. Given these findings, more attention should be given to non-hip, non-vertebral fractures that constituted approximately 50% of all low-trauma fractures and were associated with more than 40% of all deaths.

Prevention and Treatment Strategies

General prevention strategies include the avoidance of modifiable risk factors such as smoking and excessive alcohol intake. As described above, the DRF often occur as a result of a fall in women with low BMD. Therefore, prevention of falls should be a priority in this patient group. All patients should be assessed for risk factors for falls including previous falls, fainting or episodes of loss of consciousness, muscle weakness, impaired balance and poor vision. Certain medications including psychotropic medications such as antidepressants and benzodiazepines, and cardiovascular medications (especially those with hypotensive effects) and non-steroidal agents may also increase the likelihood of falls, hence the need for their continuation should be regularly reviewed [32,33]. Environmental factors such as poor lighting are another risk factor for falling. There is little evidence, though, to suggest that nonpharmacological approaches lead to a beneficial reduction in falling or fracture risk [34].

It is important to be able to identify those at highest risk of future fracture to best target preventative measures. Combining several risk factors into a risk score may help to identify perimenopausal women at high risk of distal forearm fracture. An example could be the FRAXtm model [35]. Clinicians can input easily obtained clinical data to estimate risk. The estimate can be used alone or with BMD to enhance fracture risk prediction. The application of this tool to clinical practice requires a consideration of the fracture probability at which to intervene.

Effective treatments are available that can significantly reduce the risk of primary and secondary fragility fractures. Although the association between prior fracture and future fracture is well established in the current literature, it appears that few elderly patients with previous fractures are receiving treatment to prevent further fractures. Approved pharmacological interventions for osteoporosis include bisphosphonates, strontium ranelate, raloxifene, denosumab and parathyroid hormone peptides. Of the available options, alendronate, risedronate, zoledronic acid, denosumab and strontium ranelate have been demonstrated to reduce vertebral, non-vertebral and hip fractures. Because of this broader spectrum of anti-fracture efficacy these agents are generally regarded as preferred options in the prevention of fractures in postmenopausal women. This distinction is important because, as described above, once a fracture occurs, the risk of a subsequent fracture at any site is increased independent of BMD, and hence an intervention that covers all major fracture sites is preferable.

Economic Cost

Osteoporosis is a highly prevalent disease and results in substantial costs both to the individual and to society through associated fragility fractures. Patients who experience fractures often must rely on several health resources, with a significant impact on the healthcare system. The annual cost of all osteoporotic fractures has been estimated at $20 billion in the USA and $30 billion in the European Union [4]. In the UK alone, the annual cost to the health-care system from osteoporotic fracture has been estimated at 1.7 billion pounds [36]. In Sweden, a prospective observational data collection study was undertaken to assess the cost and quality of life related to hip, vertebral and wrist fracture (KOFOR) [37]. The mean fracture-related cost the year after DRF is estimated, in euros (€), at €2,147. The cost estimate in the first six months following the fracture is higher in the younger group of participants (50 – 64 years) than in those older than 65 years, €2,090 and €1,891, respectively. The trend is reversed between 7 and 12 months after DRF with values of €299 and €507 in younger and older groups respectively [38]. The same study design has been used to investigate the cost and quality of life related to hip, vertebral and wrist fracture in an international perspective (The International Costs and Utilities Related to Osteoporotic Fractures Study (ICUROS)). The results from this study are awaited.

Conclusion

Osteoporosis is a highly prevalent disease and impact of the osteoporotic fracture extends from the personal level to public health through effects on the health service and economy. This review highlights the detrimental impact of distal radial fractures on mortality, morbidity and economic cost. Therefore efforts to optimize the care of patients with osteoporosis should not be focused solely on hip and spine fractures. Strategies should be developed to target more comprehensively those at high risk of DRF both for primary and secondary prevention.

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