Journal of Hand Therapy 29 (2016) 136–145

Contents lists available at ScienceDirect

Journal of Hand Therapy

journal homepage: www.jhandtherapy.org

JHT Read for Credit Article #408.
Special Issue: Wrist

Epidemiology of distal radius fractures and factors predicting risk and prognosis

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ARTICLE INFO

Article history:
Received 15 November 2015
Received in revised form
11 March 2016
Accepted 14 March 2016

Keywords:
Distal radius fracture
Epidemiology
Risk factors
Prognosis
Review

ABSTRACT

Study design: Literature Review.
Introduction: For optimal Distal Radius Fracture (DRF) rehabilitation and fracture prevention, it is important to understand the epidemiology and factors predictive of injury, chronic pain, chronic disability, and subsequent fracture.
Purpose: To summarize the literature reporting on DRF epidemiology, risk factors, and prognostic factors.
Methods: Literature synthesis.
Results: Although incidence varies globally, DRFs are common across the lifespan and appear to be on the rise. Risk of DRF is determined by personal factors (age, sex/gender, lifestyle, health condition) and environmental factors (population density, climate). For example, age and sex influence risk such that DRF is most common in boys/young men and older women. The most common causes of DRF in the pediatric and young adult age groups include playing/sporting activities and motor vehicle accidents. In contrast, the most common mechanism of injury in older adults is a low-energy trauma because of a fall from a standing height. Poorer health outcomes are associated with older age, being female, poor bone healing (or having an associated fracture of the ulnar styloid), having a compensated injury, and a lower socioeconomic status.
Conclusions: Risk stratification according to predictors of chronic pain and disability enable therapists to identify those patients who will benefit from advocacy for more comprehensive assessment, targeted interventions, and tailored educational strategies. The unique opportunity for secondary prevention of osteoporotic fracture after DRF has yet to be realized by treating therapists in the orthopedic community.
Level of evidence: V.

Introduction

Distal radius fracture (DRF) is a common wrist injury and the incidence appears to be increasing worldwide.[1-5] Recent data from a cohort of 208,094 patients from the United States revealed that the radius was the most common long bone to fracture.[6] DRF accounts for one-sixth of all emergency department visits[6,7] and 26%-46% of all skeletal fractures observed in the primary care setting.[8-13] Typically, a DRF is characterized by a low-energy fracture occurring approximately 2 cm above the distal articular surface of the radius at the junction where the cortical bone becomes thinner and is reinforced by the trabecular bone network.[14] It is most commonly caused by a fall on an outstretched hand from a standing height or lower among people older than 50 years.[15] A fracture of the distal radius may be described as a Colles, Smith, Barton, or Hutchinson fracture depending on the characteristics of the injury.[16]

Injury factors and patient factors impact the management and outcomes after DRF. Patients typically achieve optimal strength, range of motion, and function within 3-6 months, regardless of whether the injury is managed conservatively or surgically.[17] However, 16% of individuals report ongoing pain and disability at 1 year after DRF, and complications such as ongoing hand stiffness, complex regional pain syndrome, malunion, and delayed return to work may prolong the rehabilitation phase.[18-20] Furthermore, first fractures are associated with an 86% increased risk of future fragility fractures when systemic bone loss because of osteoporosis (OP) is present.[21] High-quality evidence suggests that DRF is an early and independent predictor of future OP fractures at other skeletal sites.[22,23] For example, cohort data from Rochester, Minnesota suggest that a DRF is associated with an increased risk of vertebral fractures, (5-fold for women and 10-fold for men)[24] and a 2-fold increase in hip fracture in women older than 70 years.[25]

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http://dx.doi.org/10.1016/j.jht.2016.03.003

Understanding the factors that predict risk and prognosis for DRF is essential to identify the overall socioeconomic burden, prevention, and better treatment post DRF as well as secondary prevention of future osteoporotic fractures.

The global population is aging,[26,27] and the aging population expects to be living active and independent lives.[28] The incidence of DRF is increased in older adulthood[29-31] and is positively associated with increased physical activity levels.[3] These global issues underline the need for this review, which aims to summarize the literature reporting on DRF epidemiology, risk factors, and prognostic factors.

Epidemiology

Because DRFs are common, the epidemiology of this injury is important for hand therapists to consider in planning rehabilitation strategies and developing prevention initiatives. In a sample of more than 87 million Americans with an upper extremity fracture in 2009, the most common fracture sites were the distal radius and ulna.[5] Furthermore, this fracture site was most common for each age group with the exception of 18-34 year olds and 35-49 year olds, where it was third and second most common, respectively.[5] The incidence of DRF is increased in older adulthood,[29-31] whereas a study of 208,094 working age Americans who sustained a fracture reported that the radius was the most common injury site.[6] Taken together, DRF is a common fracture across the life span.

The overall incidence of DRF varies around the globe and has changed markedly in last few decades.[3,32] To compare rates of DRF in different countries, Table 1 summarizes incidence rates reported for 5 geographic regions: North America (United States[5], Canada[33]), Oceania (Australia[34,35], New Zealand[36]), Europe (Denmark[37], United Kingdom[38], Netherland[39], Norway[40,41], Switzerland[42], France[43], Iceland[44], Sweden[2], Finland[45]), Asia (Taiwan[46], Korea[47,48], Japan[49,50]) and Africa (Nigeria[51], Cameroon[52]). Within each region, the publications are presented in chronological order according to the study period. The global variation in the estimated annual incidence of DRF is difficult to interpret given methodological variations in sampling frames and fracture identification. Figure 1 depicts the sampling strategies used in the studies reporting annual incidence rates. Regions with the capacity to access central health records representative of the larger population, more commonly used in European countries, will provide more accurate estimates as these studies tend to be larger and less subject to bias. Figure 2 illustrates the various methods used to identify DRF as a function of continental region. Radiographic confirmation of a DRF provides more accurate accounts. Notwithstanding these limitations, Table 1 indicates that the incidence of DRF is higher in Scandinavia (North Europe), New Zealand (Oceania), and North America than regions closer to the equator such as the study locations in Asia and Africa. Of note, the incidence of DRF appears to be rising when current rates are compared with previous rates within the same region.[3]

Risk factors

Age and sex/gender

The incidence of DRF has a bimodal distribution during the life span. The incidence is high in the pediatric population, drops during young to middle adulthood, and increases again in older adults (Table 1). Table 1 indicates that adults 50 years of age or older and children 18 years of age or younger sustain more DRF compared with middle-aged adults across all countries. Figure 3 illustrates the global gender-specific annual incidence rates of DRF reported among adults 50 years of age and older. Figure 4 illustrates the global gender-specific (or total) annual incidence rates of DRF reported among the pediatric (18 years and younger) population (or total rate where separate data are not provided).

Sex is a determinant of DRF, which varies as a function of age (Figs. 3 and 4). According to Court-Brown and Caesar,[53] sex and age distribution curves for DRF incidence in the pediatric group indicate that boys have a higher risk of DRF than girls. This sex difference continues during young to middle adulthood with men aged 19-49 years having more DRF than women of the same age. Beyond that age, the rate of DRF increases markedly such that women older than 50 years have a 15% lifetime risk, whereas the incidence in men remains low until they reach the age of 80 years.[31] Globally, injury rates remain significantly higher in elderly women as compared with elderly men (Table 1). In a study of American adults older than 65 years, the risk for DRF was almost 5-fold greater in women than in men.[54] Men aged 50 years or older are more likely to report a traumatic mechanism of injury than women in the same age range.[31]

Lifestyle, population density, and seasonal factors

The most common causes of DRF in the pediatric and young adult age groups include playing/sporting activities and motor vehicle accidents. In contrast, the most common mechanism of injury in older adults is a low-energy trauma because of a fall from a standing height.[46,55,56] People living in rural areas (<5000 citizens) are more likely to suffer a high-energy fracture, even after adjusting for other risk factors (younger age, being male, and summer season).[41] In this same study, Diamantopoulos et al[41] found that more men and women older than 50 years living in an urban area of Southern Norway suffer a low-energy DRF compared with adults of the same age living in a rural area. This study also shows that DRF, regardless of cause, and low-energy fractures specifically, occurred most frequently during the Southern Norwegian winter season ($P < .01$), suggesting a greater risk among older adults living in areas with ice and snow.[41] In contrast, a higher incidence of DRF is observed during the summer in Taiwan, which is hypothesized to be because of typhoons causing people to slip and fall.[46] Thus, lifestyle, population density, and environmental factors contribute to DRF and should be considered when designing programs for rehabilitation and prevention as well as materials for patient education.

Health conditions

DRF appears to occur less often in individuals with significant dementia.[3,56] Most of the low-energy fractures occurring in older adults are attributed to the reaction of stretching out the hand to stop a fall or loss of balance. In keeping with this mechanism of injury, women with good neuromuscular control and faster walking speeds were found to be at higher risk for DRF compared with women who lack the reaction time required to break the fall with their hand and were more likely to land on the upper arm or hip.[56] Given that many DRFs are caused by low-energy trauma that would be insufficient to cause a normal bone to break, OP and other health conditions resulting in poor bone quality (such as chronic stroke, diabetes, rheumatoid arthritis, and kidney disease) are significant risk factors. Studies of postmenopausal women with DRF report that most (for example, 70-80%[55,57]) of the sample have low bone mass. During middle age (45-65 years), a DRF because of a fall from a standing height or lower may be the first clinical manifestation of OP for a small subset of people.[55,58] When health conditions exist, which cause both loss of bone strength (eg, OP) and deficits in dynamic balance (eg, chronic stroke or diabetic