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Distal Radius Fracture Outcomes and Rehabilitation

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Abstract

Distal radius fractures account for nearly 1 of every 5 fractures in individuals aged 65 or older. Moreover, increased susceptibility to vertebral and hip fractures has been documented in patients a year after suffering a distal radius fracture. Although women are more susceptible to hip fractures, men experience a higher mortality rate in the 7 years following a distal radius fracture. Traditional approaches to distal radius fractures have included both surgical and nonsurgical treatments, with predominant complaints involving weakness, stiffness, and pain. Nonsurgical approaches include immobilization with or without reduction, whereas surgical treatments include dorsal spanning bridge plates, percutaneous pinning, external fixation, and volar plate fixation. The nature of the fracture will determine the best treatment option, and surgeons employ a multifactorial treatment approach that includes the patient's age, nature of injury, joint involvement, and displacement among other factors. Historically, closed reduction and percutaneous pinning have been the most popular approaches. However, volar plate fixation is quickly becoming a popular option as it minimizes tendon irritation, reduces immobilization time, and decreases risk of complication. The goal of treatment is to restore mobility, reduce pain, and improve functional outcomes following rehabilitation. The aim of this review is to summarize the most common treatments and importance of early referral to hand therapy to improve functional outcomes.

Keywords

adult reconstructive surgery, fragility fractures, geriatric medicine, geriatric trauma, osteoporosis, upper extremity surgery

Introduction

Distal radius fractures have a high incidence among the aging population and may potentially result in poor functional outcome and impairment.[1,2] The incidence of distal radius fractures increases in women aged 65 and older due to the greater risk of osteoporosis.[3] Postmenopausal women are likely to develop bone-related problems due to decrease in estrogen production, which has been shown to help prevent excessive bone breakdown. Age-related fragility is a consequence of accelerated bone breakdown and increases the risk of developing osteopenia and osteoporosis. Consequentially, 85% of elderly women exhibit low bone density and 51% have osteoporosis.[4] Conversely, men have less severe fractures than women in part due to the reduced prevalence of osteoporosis.[5] Moreover, dual-energy X-ray absorptiometry scans revealed higher bone mineral density in men than in women.[5] Distal radius fracture represents 18% of all fractures in patients aged 65 and older, but anatomical reduction in these patients does not correlate with clinical outcome. This number may increase in the future due to the combination of a longer lifespan and low bone density. Nellans et al reported that women who suffered a wrist fracture were 50% more likely to report a functional decline when compared to women without fractures.[6] This number represents all wrist fractures. However, mortality rates increased 14% in 7 years following a fracture; and men who suffered a distal radius fracture are almost 3 times more likely than women to die during that time period.[6] Nellans et al also reported a 5 and 10 times greater rate of vertebral fractures in women and men, respectively, a year after suffering a distal radius fracture.[6] Within the same time period, women over the age of 70 have a 60% increased rate of hip fractures.[6]

Traditionally, distal radius fractures in those over the age of 65 have been treated both nonsurgically and surgically. Nonoperative (nonsurgical) options include immobilization with or without reduction, where the fractured bone is reduced without

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opening the skin and then subsequently immobilized to avoid potential displacement of fracture while healing. Although bone heals naturally, closed reduction can minimize the risk of infection, which is a rare but possible complication using surgical treatment.[7] Closed reduction is also commonly used in the treatment of displaced extra-articular fractures by immobilizing the region to limit injury to the soft tissues, tendons, and nerves caused by the displaced bone fragments.[7,8] Healing time is neither increased nor decreased in closed reduction, but long periods of immobilization may exacerbate stiffness and increase the risk of developing osteopenia.[8]

Surgically, volar (locking) plate fixation is a procedure that is becoming increasingly popular (due to newer plate designs) and is used in more complex fracture cases that include severe fragmentation or significant articular displacement.[9] Volar plate fixations can be used for the treatment of both intra-articular and extra-articular fractures and as a revision technique when the use of pins and external fixation fails.[9] It can also be used to fix simple, dorsally displaced, and comminuted fractures. The use of volar plates achieves the benefits of stable internal fixation and minimizing tendon irritation, while avoiding the shortcomings of other traditional approaches. These shortcomings include longer immobilization times and higher rates of complication.[9,10]

Distraction or dorsal spanning bridging plates is rapidly becoming a viable treatment method due to the benefit of permitting fixation without relying on bone quality. Moreover, it allows for early weight bearing.[11] Percutaneous pinning and external fixation are techniques that are still commonly used but may not represent the best options for the elderly patients because they rely on ligamentotaxis and fail to achieve anatomic reduction in the specific fragments.[12] Moreover, these percutaneously exposed hardware can be cumbersome to care for and have increased risk of infection.[7,12] The osteoporotic bone commonly seen in elderly patients further complicates the treatment course and makes those options less ideal. Interestingly, outcomes following both surgical and nonsurgical treatment approaches after a year have shown no significant difference.[9]

According to Chung et al, the use of closed reduction has significantly reduced from 82% in 1996 to 70% in 2005.[8] However, it still remains the most popular treatment approach among the elderly patients followed by percutaneous pinning (15.8%), internal fixation (10.9%), and external fixation (2.8%).[8] Furthermore, they postulated that the increasing trend in operative approaches was due to the refinement of surgical technique that reduced the risk of postsurgical complications, while improving recovery time. Despite apparent radiological differences, functional outcomes following both nonsurgical and surgical procedures were similar after a year of treatment.[9]

The treatment algorithm is multifactorial, taking into consideration the patient's age, activity level, bone quality or strength, occupation, previous or current injuries, joint involvement, extent of fracture displacement, and involvement of joint surface.[13,14] For patients aged 85 and older, 80 to 84, 75 to 79, and below 74, closed reduction is used 87%, 81%, 76.6%, and 73% of the time, respectively. Percutaneous pinning is the second most common treatment option, representing 8.6%, 11.9%, 13.9%, and 15.2% for the same age brackets. Finally, internal fixation represents 3.4%, 5.5%, 7.6%, and 9.2% for the same age brackets as well. With the exception of closed reduction, the trend shows decreasing use in techniques with increasing age. Patients with good bone quality, limited fracture displacement, and minimal involvement of joint surface are commonly treated with closed reduction.[8,14] With extensive fracture displacement and poor bone quality, the age of the patient can help decide the most appropriate surgical treatment approach.[8,14]

Rehabilitation can be beneficial and critical for improving functional outcomes following the treatment of distal radius fractures for some patients. The rehabilitative process is often complicated by challenges associated with prolonged recovery times, discomfort, pain, and decreased mobility. Despite these challenges, the clinical outcome following distal radius fractures is acceptable, the majority of patients showing no or minimal disability based on the Disability of Arm, Hand, and Shoulder (DASH) scores.[15] However, complications such as nonunion or malunion may result in altered mechanics of the wrist, resulting in permanent functional impairment and pain. Common complaints following distal radius fracture include weakness, pain, and stiffness.[15]

Rehabilitative Goals Following Distal Radius Fracture Treatment

The focus of distal radius fracture rehabilitation is to manage pain and allow the patient to regain motion, strength, and most importantly, function.[16] Rehabilitation of distal radius fractures is divided into 3 stages: splinting (for edema control), mobilization, and strengthening.

With appropriate rehabilitation, typical outcomes for wrist flexion, extension, pronation, and supination at 1-year follow-up are 59°, 63°, 80°, and 81°, respectively.[17] At 1-year follow-up, similar wrist motion is attained independent of the type of fixation employed or the duration of immobilization. Although wrist range of motion (ROM) is a commonly reported functional outcome measure, patient-reported outcomes are more closely related to the preservation of digit mobilization.[12] Thus, patient can benefit from early therapy to improve digit motion, even while the hand is mobilized in a cast.

During the period of splinting, ROM exercises should be initiated in the digits through both passive (assisted) and active exercises. Early therapy programs focus on increasing ROM of the digits, wrist, and forearm while the wrist is immobilized.[10] Therapists are able to focus on preventing finger, elbow, and shoulder stiffness in addition to reducing edema. A key goal is to educate patients in early fine motor and dexterity activities. Unfortunately, less than 10% of patients with distal radius fractures are referred to therapy during this critical period of immobilization.[16]

Time frames when patients begin mobilization vary based on the treatment. Advances in the use of volar plating for the

treatment of distal radius fractures allow for early ROM 7 to 10 days postoperatively in stable functions, whereas mobilization following closed treatment in a cast typically begins after immobilization lasting up to 6 weeks.[10] During the mobilization period, the goals of pain and edema control continue with the addition of improving wrist motion and overall function. Valdes[10] conducted a retrospective study that examined the mean number of therapy visits required to regain motion between an early ROM group treated with open reduction and internal fixation and a late ROM group treated with closed reduction and casting following distal radius fractures. The mean number of therapy visits in the early ROM group was 6.57 days versus an average of 17 therapy days in the late ROM patients.[10]

The final phase focuses on return to normal activity through strengthening exercises and simulated activities. At this phase of the rehabilitation program, patients are discharged to a home program. Therapists typically assume the role of a coach and assist patients in adhering to their programs in order to reduce their perceived level of impairment.[18]

Outcome Measures Following Distal Radius Fracture Treatment

Outcome measurements assess impairment and overall function. Following a distal radius fracture, patient outcome is assessed using several variables including radiographic outcomes, ROM, grip strength, pinch strength, and patient-rated functional outcome measures.[15] It is important to note that the radiographic outcomes do not correlate with the functional outcome.[9]

A successful clinical outcome after distal radius fracture has traditionally been based on objective measures such as improved radiographic parameters, wrist ROM, and grip strength. However, patients are more interested in their ability to complete everyday functional activities. Recently, focus has shifted to the psychosocial effects of injury, leading to the development of patient-rated outcome measurement systems.[17,19]

Two commonly employed patient-rated functional outcome measures are the DASH and Michigan Hand Questionnaire (MHQ) scales. Both of these measures use self-evaluation of a patient's perspective on their upper extremity injury. The DASH is a validated outcome measure that consists of a 30-question survey, with a lower score indicating better function.[3] The MHQ measures outcomes utilizing 6 scales including overall hand function, activities of daily living, pain, work performance, aesthetics, and satisfaction with hand function.

Studies have investigated whether scores on patient-rated functional outcome measures are correlated with radiographic and objective findings in the setting of distal radius fractures. Shauver et al[17] examined functional outcome variables related to the MHQ score. Their study found that the MHQ score was significantly affected by grip strength but not by ROM measurements. In their retrospective study, Wilcke et al[15] examined the correlation between radiographic findings, objective measurements, and DASH scores. Their findings indicate that a better score on the DASH correlated with final radiographic findings and objective variables of both grip and wrist extension. However, Kumar et al[20] reported that among an elderly cohort of patients older than 60 years, both DASH and MHQ scores were rated satisfactorily, despite radiographic findings of dorsal angulation.

Although wrist ROM is one of the most commonly reported outcome measures after a distal radius fracture, several studies have failed to establish a correlation between this parameter and patient-rated outcomes.[15,17] However, there is literature to suggest that early digit mobilization is likely the determining factor of patient satisfaction.[12]

Conclusion

The current changes in health care coupled with the increasingly active lifestyles of the elderly patient warrant a closer assessment of treatment options for distal radius fractures. Clinical decision-making pertaining to elderly patients is different from younger patients and must account for factors such as bone quality, joint involvement, occupation, activity level, current or previous injuries, and fracture type. Treatment with internal stabilization such as volar plating allows for early active motion and reduces the potential for fracture displacement during lengthy periods of casting following closed reduction. However, other options are available and can be utilized based on the type of fracture the patient suffered among other factors. Early involvement in a therapy program can be beneficial to some patients and may ultimately reduce the number of therapy visits required to regain functional strength and motion.

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