Journal of Hand Therapy 32 (2019) 17–24

Contents lists available at ScienceDirect

Journal of Hand Therapy

journal homepage: www.jhandtherapy.org

JHT Read for Credit Article #585.
Scientific/Clinical Article

Changes in fall risk and functional status in women aged 50 years and older after distal radius fracture: A prospective 1-year follow-up study

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ARTICLE INFO

Article history:
Received 7 June 2017
Received in revised form
29 September 2017
Accepted 29 September 2017
Available online 14 November 2017

Keywords:
Rehabilitation
Fragility
Fracture recovery
Functional recovery
Fall risk

ABSTRACT

Study Design: Prospective cohort study.
Introduction: Few studies have evaluated the course of recovery after distal radius fracture (DRF) when functional decline and fracture risk may be affected.
Purpose of the Study: The purpose of this study was to determine changes in overall functional status over the first year after a DRF in women aged 50 years and older.
Methods: Seventy-eight women were assessed for balance, balance confidence, lower extremity strength, gait speed, fall history, physical activity levels, and self-reported wrist pain and function (Patient-Rated Wrist Evaluation) at weeks 1, 3, 9, 12, 26, and 52 after DRF. Descriptive data were generated for all variables; a 3-way mixed analysis of variance with repeated measures was used to compare differences between participants aged 50-65 years and 65 years and older.
Results: There was a significant improvement in functional status measures for both age categories except single-leg balance and fast gait speed, from 1 week after fracture extending up to 1 year after fracture (ranging from 6.1% improvement to 25% improvement, $P < .05$). There was no significant time × age interaction, as both age groups had the same pattern of recovery; however, there was significantly lower functional status in the older group across all time points.
Conclusion: Regardless of age, monitoring and addressing functional status including upper limb function, overall strength, balance, confidence, usual gait speed, and physical activity right up to 1 year after fracture is an important consideration for clinicians treating women recovering from DRF. Given the high future fracture risk for these women, identifying functional recovery patterns can help to direct future research and determine preventative strategies.

Introduction

Distal radius (wrist) fractures are the most common fracture across the lifespan, accounting for one-sixth of all fractures, with a much higher incidence in women.[1,2] In Caucasian women, the lifetime risk of a fractured wrist is about 16% (vs 2.5% for men). The primary mechanism of this injury is a forward fall onto an outstretched hand.[2,3] The tendency to fall is one of the most important risk factors in low-energy or fragility fractures,[4] and the most important risk factor for those who experience an upper extremity fragility fracture.[5]

There is limited research evaluating physical function and fracture risk status in women aged 50-59 years[6] or the functional

This research was supported by the Royal University Hospital Foundation Grant award to Jonathan P. Farthing. Katie Crockett was supported by doctoral funding from the Bone and Joint Imaging Group at the University of Saskatchewan, with funding from the Saskatchewan Health Research Foundation (SHRF). Charlene RA Haver was supported by CGS doctoral funding from the Natural Sciences and Engineering Research Council of Canada and Dean's scholarship funding from the University of Saskatchewan.
This study has been approved by the University of Saskatchewan Institutional Review Board.
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https://doi.org/10.1016/j.jht.2017.09.009

changes that occur throughout the first year of recovery after wrist fracture, which may increase future fall or fracture risk. Cho et al suggest that the increased risk of wrist fractures in this age group may be the combination of maintained levels of physical activity and subtle declines in physical performance. This is supported by findings that women who walk regularly have a higher risk of distal radius fractures (DRFs), compared to those who did not walk regularly.[7] With potentially faster walking speeds, moving more quickly, or more active lifestyles, women may frequently put themselves in situations where they are more likely to fall. This brings to question the utility of commonly used functional outcome measures such as walking velocity, activity levels, and balance[8-10] in identifying women at risk of fractures and falls in the early postmenopausal years.

Understanding the changes that occur in functional status over the first year after fracture may assist in determining why risk of future fracture increases following an early fragility fracture. A prior longitudinal study suggests that the majority of individuals suffering from a DRF will recover upper extremity motion and strength within 6 months after fracture, although a minority experience functional disability up to a decade thereafter.[1] Range of motion at the wrist and grip strength have been shown to be diminished at 1 year after fracture, with mean grip strength at 88% of the uninjured hand adjusted for dominance.[1] About 8% continue to experience increased pain (moderate to very severe) and disability outcomes (Disabilities of the Arm Shoulder and Hand, Patient-Rated Wrist Evaluation [PRWE]).[1,11] Despite this evidence specific to regional recovery at the upper extremity, there is little knowledge of the usual course of functional status and fall risk during the first year after a DRF and the differences that may exist between age cohorts.

Compared to women older than 65 years, postmenopausal women in their 50s and early 60s are less likely to have comorbid conditions, which are known to increase with age and can contribute to overall physical function.[12] In addition, women in preretirement tend to be more active with careers[13] and maintain physical activity levels from early adulthood.[14] Despite this, the largest population group with wrist fractures is early postmenopausal women with higher levels of activity in work or leisure.[1] Physical function impairment associated with mobility decline has been described as a consequence of sarcopenia and age-related declines in bone density.[15] A recent study confirmed that the incidence of forearm fractures treated in hospital emergency departments among women increased dramatically between age 45 and 64 years,[3] at an annual fracture rate of 3.9% among women aged 50-59 years of age. Because changes in functional status over the first year after fracture have not been examined, it is unknown if the pattern of recovery would differ in early postmenopausal women compared to women over the age of 65 years. Age of 65 years and older is the age category identified where fall risk is known to increase,[16] and thus; guidelines for which fall prevention and physical activity are directed.[17,18] It is uncertain how to direct similar guidelines for women younger than age 65 years as little is known about the comparative functional status and fall risk after fracture.

Purpose of the study

The purpose of this study was to determine: (1) how functional status changes during postfracture recovery over the first year following a DRF in older women and (2) if differences in the pattern of recovery exist in those aged 65 years and older, compared to those aged 50 to 65 years. A priori hypotheses were not set as this was an exploratory analysis; however, we expected women aged $>$ 65 years would experience a slower recovery of functional status compared to women between 50 and 65 years.

Methods

Participants

Seventy-eight women aged 50 years or older with a recent wrist fracture were recruited from an orthopedic distal radial fracture clinic (BLINDED). This clinic was a referral center from a wide base of physicians and primary health practitioners serving several regions in the province. The women recruited were part of another randomized controlled trial (RCT), which involved targeted grip strength training of the unaffected hand compared to a standard rehabilitation protocol.[19] Given no difference between intervention and control groups for fall risk measures, all participants regardless of rehabilitation protocol were included in this study. Participants were recruited within the first week after fracture and were followed at weeks 3, 9, 12, 26, and 52 after fracture, in concert with the time of their orthopedic follow-up visit. Sixty-three of the 78 participants who were assessed at baseline (81%) completed testing up to the full year after fracture. Participants included women who sustained a DRF with either surgical or nonsurgical repair. Exclusion criteria included (1) participants who sustained a prior DRF; (2) significant neurological or medical conditions that affected daily living (ie, stroke, Parkinson disease, or other systemic neurological conditions affecting balance); (3) inability to walk independently; (4) any history of upper extremity neurological problems including conditions such as reflex sympathetic dystrophy; (5) a current severe painful hand or wrist problem (eg, systemic polyarthropathy in the wrist or hands); or (6) cognitive impairment.

Procedures

All participants signed informed consent, and ethics approval was obtained from the institution's (blinded) biomedical ethical review board.

Baseline descriptive measures

Handedness was assessed by the Waterloo Handedness Questionnaire,[20] and cognitive functional status assessed by the Mini-Cognitive Screening Test.[21] A detailed fall history questionnaire and a medical and demographic questionnaire were completed at baseline.

Outcome measures

Several performance measures were used in the RCT (see Magnus et al., 2013). For the purposes of this study, we focused on overall functional status in order to determine factors contributing to potential deterioration of mobility and future fracture risk. Only the outcomes where there were no significant differences between RCT groups (ie, training and control) are reported here, in order to provide a profile of functional status for the pooled sample of women sustaining a DRF (refer to statistical analyses). Outcomes analyzed included the following.

Overall physical function

The modified Berg Balance Scale (BBS),[22] BBS single-leg stance and standing forward reach items, the 30-second (30s) chair stand test,[23] and the 50-foot walk test[24] were used to assess general functional status.

The BBS is a valid measure ($r = 0.81$) with high interrater reliability (0.98 intraclass correlation) as a useful predictor of risk for future falls in aging adults.[8] Two of the more challenging tasks in this scale (forward reach and single-leg balance) were used as

Table 1
Baseline descriptive characteristics

Characteristics	Overall group ($N = 63$)		Age < 65 ($n = 36$)		Age > 65 ($n = 27$)	
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
Age	63 (8.4)	50-84	57.4 (4.3)	50-64	70.9 (5.8)	65-84
Height (cm)	161.5 (6.6)	147.5-175.8	162.9 (6.3)	151.0-175.8	159.6 (6.6)	147.5-172.5
Weight (kg)	67.9 (13.3)	44-111.8	69.3 (12.3)	45.6-111.8	66.0 (14.7)	44-97.9
Number of Medical conditions	1.7 (2.1)	0-8	1.14 (1.7)	0-7	2.5 (2.3)	0-8
Number of medications	1.8 (1.8)	0-6	1.1 (1.3)	0-4	2.4 (1.9)	0-6

SD = standard deviation.

balance outcome measures, due to the higher functioning status of this population.[22]

For the 30s chair stand test, the participants were instructed to fully stand up and fully sit down as many times as possible in 30 seconds. This test has established test-retest reliability, interobserver reliability, and validity (intraclass correlation = 0.84-0.92, $r = 0.93$, $r = 0.78$).[23,25]

The timed 50-foot walk test has been incorporated into the physical performance test, a performance-based measure used to identify individuals who are at risk of recurrent falls,[25] with documented normative values for community-dwelling older adults.[26] The 50-foot walk test has been used to validate other functional and health status instruments and as an outcome measure for comparison of balance intervention programs in community-dwelling older adults.[24]

Testing adhered to the standard protocol validated for each measure. All testers were trained in using the standard protocol. A fall history questionnaire developed by the researchers involved in the original RCT study provided details of falls prior to the fracture and during each visit after fracture.

Physical activity status and balance confidence

The Physical Activity Scale for the Elderly (PASE) is a validated self-report questionnaire designed to assess current level of activity (occupational, household, and leisure) of community-dwelling older persons, based on the 1 week period previous to the date of administration.[10]

The Activities-specific and Balance Confidence (ABC) scale is self-report questionnaire designed to measure the psychological impact of balance impairment and/or falls.[27] Test-retest reliability has been established ($r = 0.92$) in community-dwelling older adults, as well as 84% sensitivity and 87% specificity in correctly classifying fallers and nonfallers in a cross-sectional study of community-dwelling older adults.[27]

Self-reported pain and function of the upper extremity

A PRWE was used to evaluate functional ability of the affected upper extremity. The PRWE was developed as a reliable and valid tool for quantifying patient-rated wrist pain and disability and has been validated in patients with a DRF.[28] A simple score can be computed on a scale of 100; the PRWE allows patients to rate their status from 0 to 10 for subsections of pain, activities of daily life, and work as indicators of subjective outcome.[28]

Medical and demographic history

This questionnaire was developed by the researchers to confirm exclusion criteria and to determine other medical conditions and health status that may affect fall and fracture risk.

Statistical analyses

Descriptive data were generated for all variables, as well as relevant medical and demographic information (Table 1). Missing data were replaced using group series mean, as data were determined to be missing completely at random (Little's MCAR test).[29] (see Table 2 for a description of missing data). ABC data were not normally distributed due to ceiling effects; therefore, transformed scores were used for the repeated-measures analysis of variance. A 3-way mixed analysis of variance with repeated measures with a $2 \times 2 \times 4$ design (group × age category × time) was used to (1) rule out main effects of the grip strength training intervention; (2) determine interaction effects and differences between groups of those aged 50-65 years vs those aged > 65 years at different time points; and (3) identify time changes for PASE, log-transformed ABC, PRWE, BBS single-leg stance item, BBS forward reach item, 30s chair stand test, and 50-foot walk test at fast and usual speeds. Where Mauchly's test revealed a violation of sphericity, Greenhouse-Geisser (GG) correction was used. SPSS 22.0 was used for all statistical analyses with $P < .05$ used for determining statistical significance, with a Bonferroni correction used for multiple comparisons testing.

Results

Descriptive characteristics

All participants included in the study demonstrated a negative screen for cognitive impairment using the Mini-Cognitive Screening Test.[21] Descriptive characteristics are summarized in Table 1. Thirty-six subjects (57%) were under the age of 65 years, and 27 (42.9%) were 65 years or older. Eighteen percent of the sample required surgical repair, 59% fractured their dominant wrist, with 91% being right-hand dominant. All participants received a standard written home exercise protocol to maintain mobility and strength of their fractured limb after cast removal. Twenty participants (26%) reported receiving additional physical therapy intervention. Details regarding the frequency and type of intervention received was not reported, although standard physical therapy

Table 2
Number of missing data points

	Wk 1	Wk 3	Wk 9	Wk 12	Wk 26	Wk 52
30s chair stand	—	10	—	14	15	21
BBS—reach	—	10	—	14	15	20
BBS—single-leg balance	—	12		15	15	21
50-foot walk (usual speed)	—	11	—	14	15	11
50-foot walk (fast speed)	—	11	—	14	15	11
PASE	0	—	14	—	14	20
ABC	0	—	4	—	14	20
PRWE	25	—	7	—	13	16

ABC = Activities of Balance Confidence; BBS = Berg Balance Scale; 30s chair stand = 30-second chair stand; PASE = Physical Activity Scale for the Elderly; PRWE = Patient-Rated Wrist Evaluation.
30s chair stand, BBS, and 50-ft walk were not tested at week 1 and week 9. PASE, ABC, and PRWE were not tested at week 3 or week 12. Our data were missing completely at random, as indicated by a nonsignificant Little's MCAR test: 30s chair stand, $\chi^2 = 21.65$, $P = .600$; BBS, $\chi^2 = 117.08$, $P = .180$; PASE, $\chi^2 = 76.07$, $P = .793$; ABC, $\chi^2 = 13.83$, $P = .462$; PRWE, $\chi^2 = 46.90$, $P = .352$.

intervention focused on enhanced mobility and strengthening for the affected extremity when progress was limited.

The number of medical conditions reported in the medical and demographic questionnaire ranged from 0 to 8, with 58% reporting 0 or 1 medical condition; only 9% reported greater than 4 medical conditions. The number of medications ranged from 0 to 6 (mean = 2). Seventeen percent reported taking calcium supplementation, 22% reported using vitamin D supplementation, and 11% reported being on a bone-altering medication.

Functional status (weeks 3, 12, 26, and 52)

For all included outcome measures, there was no group effect found between the intervention and the control groups; therefore, all subsequent reporting of results focuses on the differences between recovery of the 2 age categories (50-64 years and > 65 years). In summary, there were no significant age category × time interaction effects for any of the variables. This implies that the profile of change in functional status was similar for both age category groups (refer to Figure 1A-D). There were differences found for the main effect of time and between-group effect of age, reported for each variable below. Means and standard deviations for the complete sample are summarized in Table 3. Means and standard deviations for age categories (age 50-64 years and age 65 years and older) are summarized in Table 4. Functional status improved in both age categories for all measures except single-leg balance and fast gait speed, from 1 week after fracture extending up to 1 year after fracture ranging from 6.1% to 25% improvement.

30s chair stand

There was a significant main effect of time with improvement observed for both age category groups, $F_{GG}(2.6,151.4) = 4.279$, $P = .015$, and no between-subjects effect of age for 30s chair stand. Pairwise comparisons revealed an increase in chair stand repetitions from week 3 to week 52 ($P = .044$; Figure 1).

BBS—single-leg stance

There was no significant main effect of time, $F(3,177) = 0.157$, $P = .157$; however, there was a significant effect of age $F(1,59) = 15.410$, $P < .001$, with the younger age group demonstrating better performance.

BBS—forward reach

There was a significant main effect of time, $F(3,177) = 4.153$, $P = .007$ and effect of age $F(1,59) = 8.511$, $P = .005$, with the younger age group demonstrating better performance. Pairwise comparisons revealed a significant difference in reach scores from week 12 to 52 ($P = .002$), with performance declining at week 52.

50-foot (Ft) walk test, usual speed

There was a significant main effect of time, $F_{GG}(2.2, 132.1) = 7.003$, $P = .001$ and an effect of age $F(1,59) = 6.231$, $P = .015$, with the younger demonstrating faster gait speeds. Gait speed increased significantly from week 3 to 26 ($P = .008$) and week 3 to 52 ($P = .009$).

50-Ft walk test, fast speed

There was a significant main effect of time, $F_{GG}(2.0, 119.6) = 3.765$, $P = .025$ and an effect of age $F(1,59) = 9.488$, $P = .003$, with

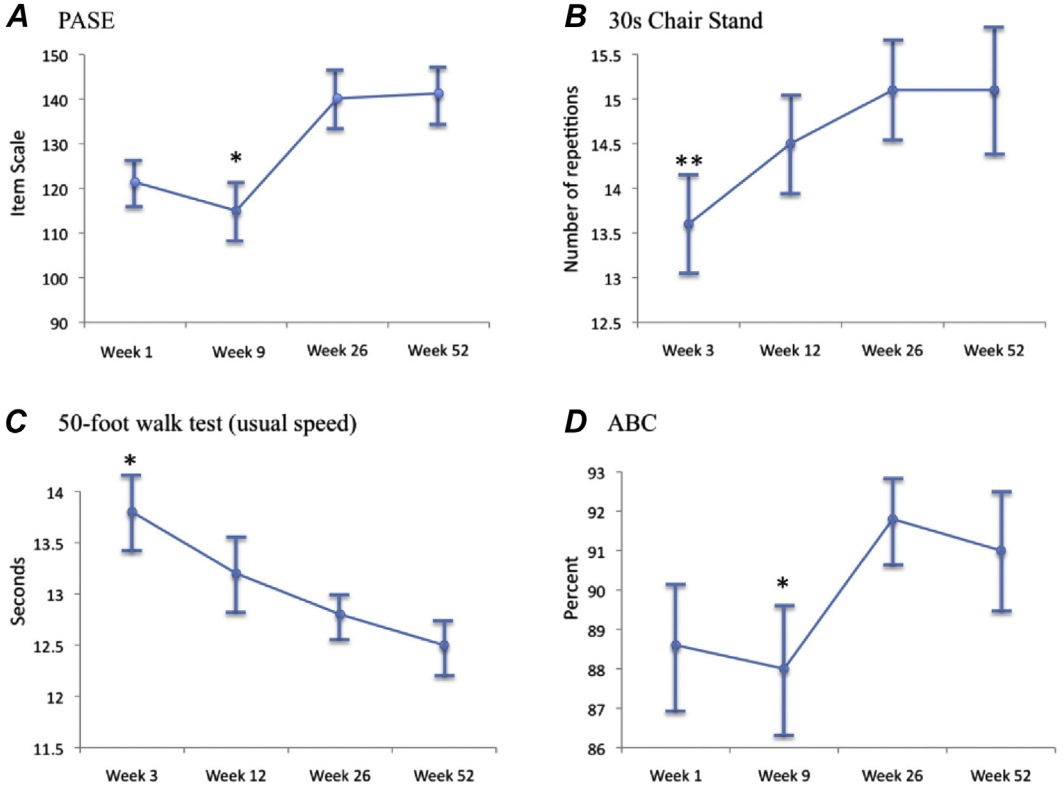

Fig. 1. Changes in (**A**) physical activity levels (PASE), (**B**) lower extremity function (30s chair stand), (**C**) gait speed (50-ft walk test), and (**D**) balance confidence (ABC) across the first year after fracture. Mean values at each time point represent the mean for all participants ($N = 63$). 30s chair stand and 50-ft walk tests were not tested at week 1 and week 9. PASE and ABC were not tested at week 3 or week 12. * Significantly different than week 26 and 52 and ** significantly different than week 52 only. ABC = Activities-specific and Balance Confidence; PASE = Physical Activity Scale for the Elderly.

Table 3
Mean (SD) scores for all primary outcome measures

	Wk 1	Wk 3	Wk 9	Wk 12	Wk 26	Wk 52
30s chair stand (reps)	—	13.6 (4.7)[a]	—	14.5 (4.5)	15.1 (4.4)	15.1 (4.6)
BBS—reach (inches)	—	12.6 (2.3)	—	13.4 (2.5)[a]	13.1 (2.5)	12.3 (2.5)
BBS—single-leg balance (s)	—	29.5 (19.7)	—	30.8 (20.35)	34.9 (19.9)	33.4 (19.9)
50-ft walk (usual speed) (s)	—	13.8 (2.5)[b]	—	13.2 (2.4)	12.8 (2.0)	12.5 (2.4)
50-ft walk (fast speed) (s)	—	10.7 (1.7)	—	10.4 (1.7)	10.3 (1.8)	9.9 (2.0)
PASE (item scale)	121.4 (84.0)	—	115.0 (67.2)[b]	—	140.2 (59.0)	141.3 (56.1)
ABC (%)	88.6 (14.5)[a]	—	88.0 (13.2)[b]	—	91.8 (10.3)	91.0 (11.5)
PRWE (item scale/100)	1.2 (1.4)[c]	—	43.2 (26.9)	—	23.1 (22.9)	14.2 (16.2)

ABC = Activities of Balance Confidence; BBS = Berg Balance Scale; 30s chair stand = 30-second chair stand; PASE = Physical Activity Scale for the Elderly; PRWE = Patient-Rated Wrist Evaluation; SD = standard deviation.
30s chair stand, BBS, and 50-ft walk were not tested at week 1 and week 9. PASE, ABC, and PRWE were not tested at week 3 or week 12.
[a] Significantly different than week 52 only.
[b] Significantly different than week 26 and 52.
[c] Significantly different than week 9.

the younger demonstrating faster gait speeds. Unfortunately, Bonferroni corrected pairwise comparisons revealed no significant differences across time.

Physical activity, balance confidence, and self-reported pain/function (weeks 1, 9, 26, and 52)

Physical Activity Scale for the Elderly

There was a significant main effect of time, $F_{GG}(2.5,146.0) = 4.279$, $P = .01$, and age $F_{GG}(1,59) = 10.052$, $P = .002$ for PASE scores. Scores increased significantly from week 9 to 26 ($P = .019$) and week 9-52 ($P = .009$) (Figure 1) with lower scores for the older age category group.

Activities of balance confidence

There was a significant main effect of time, $F(3,177) = 4.110$, $P = .008$ but no effect of age $F(1,59) = 1.925$, $P = .172$. Pairwise comparisons revealed a decrease in ABC score from week 1 to 9 (lower confidence), although this was not significant. Scores increased significantly from week 9 to 26 ($P = .019$) and week 9 to 52 ($P = .009$) (Figure 1).

Raw mean ABC scores at week 1 were the same for those aged ≥ 65 years and those aged 50-65 years ($\bar{x} = 89\%$, standard deviation [SD] =12% and 17%, respectively). However, at week 9, the older group demonstrated a decrease in ABC score ($\bar{x} = 86\%$, SD = 14%), whereas the younger group score increased slightly at week 9 ($\bar{x} = 90\%$, SD = 13%), and reached a ceiling effect by week 26 ($\bar{x} = 93\%$, SD = 10%). The group aged > 65 years consistently demonstrated lower ABC scores at week 9 ($\bar{x} = 86\%$, SD = 14%), 26 ($\bar{x} = 90\%$, SD = 11%), and 52 ($\bar{x} = 89\%$, SD = 14%) compared to the group aged 50-64 years. Independent sample *t*-tests were used to determine age category differences with the log-transformed data. There were no significant differences between ages at any time point.

Self-reported pain and function of the upper extremity (PRWE)

There was a significant main effect of time, $F_{GG}(2.3, 133.0) = 62.265$, $P < .001$ but no effect of age $F_{GG}(1,59) = 0.138$, $P = .712$. Pairwise comparisons revealed an increase in PRWE score from week 1 to 9 ($P < .001$). Scores decreased significantly from week 9 to 26 ($P < .001$) and week 26 to 52 ($P = .002$).

Discussion

This longitudinal analysis of women who sustained a DRF followed recovery of various functional status measures over the course of 1 year after the fracture. Women with a DRF are at risk of future fracture[13] and determining recovery status may help guide future decision-making related to assessment and follow-up for this population. We found that there was functional improvement over the year, regardless of whether the women were between 50 and 64 years or over 65 years. For both age category groups, functional hand and wrist recovery, balance, lower extremity strength, balance confidence, and physical activity level continued to improve right up until the end of the year after fracture. Although we did not have prefracture measures for comparison, the pattern of recovery suggests that there may be an immediate decline in physical function after DRF with a slow recovery to follow. This pattern of recovery was similar across both age category groups, suggesting both younger and older women do not fully achieve their full potential of functional status until up to 1 year after fracture.

With the increased incidence in DRFs in women aged 45-64 years,[3] and the resultant escalation of future fracture risk following this first “signal” fracture, determining the potential risk factors in the recovery period is clinically important. Current guidelines to screen for fall risk, focused on older adults age 65 years and older, recommend an evaluation of gait and balance,[16] suggesting

Table 4
Mean (SD) scores for age categories: age 50 to 64 years ($n = 36$) and age 65 years and older ($n = 27$)

	Single-leg balance (s)		Forward reach (cm)		50-foot walk (usual speed) (s)		50-foot walk (fast speed) (s)		PASE (item scale)	
	Age 50-64	Age 65+	Age 50-64	Age 65+	Age 50-64	Age 65+	Age 50-64	Age 65+	Age 50-64	Age 65+
Wk 1	—	—	—	—	—	—	—	—	141.6 (96.9)	94.5 (53.6)
Wk 3	34.8 (20.1)	22.3 (15.4)	13.2 (2.0)	11.8 (2.4)	13.3 (2.3)	14.4 (2.6)	10.2 (1.3)	11.3 (2.1)	—	—
Wk 9	—	—	—	—	—	—	—	—	134.7 (71.8)	88.6 (50.7)
Wk 12	37.9 (20.3)	21.3 (16.4)	14.0 (2.3)	12.6 (2.5)	12.6 (2.0)	14.0 (2.7)	9.9 (1.3)	11.1 (2.0)	—	—
Wk 26	42.5 (17.5)	24.9 (22.6)	13.8 (1.7)	12.3 (3.1)	12.3 (1.8)	13.4 (2.1)	9.8 (1.5)	11.0 (1.9)	134.7 (71.8)	88.6 (50.7)
Wk 52	39.3 (18.1)	25.9 (22.6)	12.7 (2.5)	11.8 (2.5)	12.0 (2.6)	13.2 (1.8)	9.5 (2.0)	10.5 (1.7)	158.9 (52.2)	117.8 (53.2)

PASE = Physical Activity Scale for the Elderly; SD = standard deviation.
Only variables where there was a between-subjects effect of age category are reported here ($P < .05$). Single-leg balance, forward reach, and 50-ft walk were not tested at week 1 and week 9. PASE was not tested at week 3 or week 12. There was no significant age category × time interaction for any of these variables.

common tests such as the BBS, timed up and go, and Performance Oriented Mobility Scale.[16] Clinical practice guidelines suggest an evaluation of gait and balance be performed for any older adult reporting a fall in the past 12 months.[16] Despite evidence that balance begins to decline by the fourth and fifth decades of life,[30] there are currently no guidelines for screening for fall risk in those younger than age 65 years. Additionally, standard balance measures to detect functional declines in older adults are typically designed for age 65 years or older. We attempted to address the potential ceiling effect of these measures such as the BBS by utilizing the more challenging components. There was a significant improvement in scores in all functional measures indicating a likely decline in function, followed by functional recovery throughout the first year, except for the single-leg stance time and an unexpected decrease in forward reach performance. With the forward reach test, participants were already reaching well beyond the fall risk threshold of 7 inches,[31] so the slight decline in forward reach performance is less concerning. The mediolateral stability, tested by decreasing the mediolateral base of support with single-leg stance was not significantly affected after fracture; however, there was a significant difference between the age categories for both single-leg stance and forward reach where older women had poorer balance performance.

The best-suited performance measures to identify changes in functional status after fracture are uncertain, which may be more subtle in the younger age category. Cho et al[14] suggest that there may be early subtle declines in physical performance in women over the age of 50 years with a recent DRF, which was identified with a chair stand test and grip strength but not from total scores on the physical performance battery or physical activity level, estimated by time per week spent on walking. In our study, the 30s chair stand test demonstrated a significant improvement between week 3 and week 52. Scores ranged from 6 to 32 repetitions in the younger group and 0 to 36 repetitions in the older group; however, means ranged from 14 to 16 in the younger age category and 13 to 14 in the older age category (above the threshold for fall risk and within norms established for women over the age of 60).[23] It is interesting to note that there were changes that did occur to lower extremity function following an upper extremity fracture. Although we do not know prefracture scores, there was a significant improvement in scores over the first year, suggesting a decline occurred immediately after fracture. This may be associated with the observed decline in physical activity as identified by a decline in PASE scores early after fracture or a change in participation in activities that were not captured in the PASE. Work and leisure activity would be affected not only by the cast but also by functional decline of the hand and wrist following cast removal. Chair stand ability not only relates to strength, but also balance, particularly forward weight shift[32] and leg power.[33] A poorer performance of chair stand after DRF, compared to age-matched controls is consistent with previous research evaluating differences in physical performance between a group with and without a recent DRF.[14] This could reflect changes in physical activity level resulting in leg strength deterioration or diminished forward balance or confidence in weight shifting forward. Further research could help determine the factors to explain this.

Similarly, the 50-foot walk test, at both usual and fast speeds, was faster between baseline and 6 months after fracture with continued increases up to 1 year. The younger age category consistently demonstrated faster gait speeds with both their usual and fast speeds. Because we used a 50-foot walk test that included a turn-around midway, we were unable to calculate gait velocity; however, 50-ft walk times were progressively faster throughout the recovery phase. This study found slower gait speeds immediately after the fracture (first measured at week 3 after fracture), coinciding with decreased physical activity levels, lower extremity strength, and balance confidence changes. Since baseline prefracture values could not be established, the scores were compared to normative values and/or the change from the previous time point where possible. Scores on the functional measures including the BBS reach and single-leg balance, 30s chair stand test, and 50-foot walk test changed over the first year, but mean values consistently remained above fall risk levels.

Low physical activity levels have been associated with poor balance, falls, and fractures.[12,18,34] Physical activity levels (PASE scores) were lower immediately after fracture and further reduced at 9 weeks, which coincided with the time frame after cast removal. Scores then increased at week 26 and further at week 52, close to baseline values. Because of the nature of the PASE, participants were asked to estimate their physical activity levels the week prior to their fracture, providing us with a prefracture estimate of physical activity levels and the ability to compare scores at 52 weeks. Therefore, the period of casting immobilization may contribute to initial declines in physical activity as the cast interferes with typical activities, especially if the dominant hand is fractured, which could in turn contribute to other health-related aspects of life.[35] The decreased physical activity levels post cast removal could be explained by a reduced level of confidence, where ABC scores at 9 weeks were also lower compared to week 52. This could also be associated with coinciding symptoms such as loss of range of motion and weakness. Self-reported pain and dysfunction (PRWE) specific to the upper extremity increased from week 1 to week 9. This was expected due to the fracture and the limitations caused by the cast, and considering week 1 was reported as participants' recall of prefracture pain and function. Scores then decreased continually to week 52, but pain and dysfunction remained higher than baseline values. This is consistent with previous literature reporting the typical recovery of pain and function during the first year after fracture, with the majority of individuals expected to have minimal pain and disability by 6 months, and a minority still reporting pain and disability at 1 year.[11] Importantly, physical activity levels, as measured by the PASE followed similar trends as the 30s chair stand test, 50-foot walk test (usual speed), and balance confidence as measured by the ABC, suggesting that physical activity levels may be related to functional ability during postfracture recovery. Encouraging and supporting women after DRF to be more physically active throughout their recovery may be a simple and feasible practice recommendation; however, ensuring safety and adequate functional recovery before returning to higher risk physical activity is also an important consideration for this population. Future research should explore facilitators and barriers of engaging in physical activity after DRF, as well as the relationship between differential rates of physical activity participation and recovery of overall functional ability following DRFs.

Interestingly, balance confidence remained high, even immediately after fracture, with the majority of participants (92%) scoring greater than 67%, thus being considered "not at risk of falling."[36] Although there was a decrease in mean scores between week 1 and week 9, coinciding with decreased physical activity levels, this was not significant and mean values remained higher than the fall risk cutoff for both age groups. These results suggest that there may be a lack of sensitivity with this scale or that confidence was not influenced by a wrist fracture within this study sample. This could be due to multiple testing time points, and therefore more regular visits, and input from a variety of health professionals, specialists, and research assistants during the 1-year recovery period. However, other studies report similar high scores in balance confidence in women over age 45 years with a recent DRF, with a mean score of 92% (±10.2%).[37] It is possible that a fall

resulting in a DRF does not impact balance confidence in this population.

We recognize the limitations of this study, as participants were those attending routine follow-up visits with 1 orthopedic surgeon at 1 particular clinic. The strength of this research environment was the standardization of visits and follow-up care; however, even though there was a diverse referral base to the clinic, results may not be generalizable to other women sustaining fracture who do not receive the same level and type of care. It is possible that our cohort may have been higher functioning and may not be representative of more frail women sustaining a DRF. In addition, we were unable to collect premorbid data to allow comparison to true baseline values, and we did not collect age-matched control data without a recent DRF. In order to allow participants to manage the large number of outcome measures and reduce the number of dropouts over the data collection period of 1 year, not all data were collected at each time point. The sample size did not allow for further subanalyses, such as comparing those with a dominant arm fracture vs nondominant arm fracture, or statistical comparison to reported age criterion normative values.

Conclusion

In conclusion, women aged 50-65 years and over age 65 years improve their functional performance after wrist fracture; but for both age categories, this can take up to a full year after fracture. This is an important clinical finding, as changes can be observed in physical function beyond just recovery of wrist strength and range of motion. Women older than 65 years demonstrated poorer function compared to women under the age of 65 years; however, the similarity in recovery patterns for both groups suggests screening and the identification of declines in functional status may be important for both age categories in order to decrease future risk for falls and fracture. This is consistent with previous suggestions for hand therapists to include fall and fracture risk screening after a wrist fracture.[38] The findings provide a snapshot for clinicians of a course of recovery after DRF, which is not only specific to the wrist, and may direct future research regarding the need to develop both screening and rehabilitation protocols by addressing factors such as lower extremity function, gait speed, and balance. Due to the increase of reported falls and DRFs peaking between ages 45 and 65 years, future research should focus on this age group in order to inform prevention practice.

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1. The study design is
   a. RCTs
   b. prospective cohort
   c. retrospective cohort
   d. case study
2. The two groups were female DRFx patients aged
   a. 45-75, and 80 and older
   b. 40-50, and 60 and older
   c. 65-70, and 75 and older
   d. 50-65, and 65 and older
3. Differences between groups was statistically determined using
   a. Pearson coefficients
   b. Student T Tests
   c. a three way ANOVA
   d. mean differential analysis
4. The investigators found
   a. a significant difference in pattern of recovery
   b. no improvement in fast gait speed and single leg balance
   c. no improvement in functional status
   d. no improvement in overall strength
5. The article suggested specific treatment strategies to manage the risk of falling in female patients who had sustained DRFx
   a. false
   b. true

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