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ORIGINAL ARTICLE

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A randomised clinical trial of activity-focussed physiotherapy on patients with distal radius fractures

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Abstract *Introduction*: Physiotherapy is considered by some authorities to be an important aspect of management in patients following distal radius fractures. There is evidence of improvement in impairment with physiotherapy; however, there is no evidence to support early return of functional activity. Traditional physiotherapy management has focussed on improving impairment; however, there are no trials with emphasis on skill acquisition via motor re-learning principles. *Materials and methods*: Forty-one participants with conservatively managed distal radius fractures were studied in a randomised, single-blinded, prospective trial. Two treatment options were compared: exercise and advice versus activity-focussed physiotherapy with measurement periods of 6 weeks after removal of cast and follow-up at 24 weeks. *Results*: Participants allocated to the exercise and advice group consulted a physiotherapist an average of 0.9 (SD 0.4) times, while the participants allocated to the more intensive activity-focussed group consulted with physiotherapy a mean of 4.4 (SD 2.3) times. At both 6 and 24 weeks there were no significant differences between the groups for change in impairment (as measured by grip strength, range of motion of wrist flexion and extension and pain intensity), activity limitation and participation restriction, as measured by the Patient-Rated Wrist Evaluation (PRWE). Exercise and advice given by a physiotherapist were equally as effective as activity-focussed physiotherapy in recovery both at 6 and 24 weeks. *Conclusion*: The results suggest that after removal of cast from fracture of distal radius, patients may routinely require no more than a single session of advice and exercise provided by a physiotherapist.

Keywords Distal radius fracture · Physiotherapy · Rehabilitation

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Introduction

Distal radius fractures are common and important clinically: approximately one in seven women over the age of 50 years will sustain a distal radius fracture in their lifetime and women over the age of 70 who sustain a distal radius fracture are twice as likely to sustain a subsequent hip fracture [12]. Physiotherapy is considered by some authorities to be an important aspect of management although another viewpoint is that the effect is overestimated [13, 14, 21]. Physiotherapy after fracture of the distal radius has included modalities such as exercise prescription, manual therapy, massage, advice on protecting the fracture, guidelines on return to safe activity, ensuring control of swelling and maintaining skin integrity [5, 13, 17, 20, 21]. Clinical trials have suggested that physiotherapy may be beneficial in improving the impairment of restricted range of motion after fracture of the distal radius [15, 20, 21]. These findings may be consistent with the goal of restoring pain-free active movement [11]. With this approach, assessment and treatment are based on measurements of impairment such as pain and loss of range of movement. It is assumed that reducing impairment will correlate to improving activity (such as activities of daily living) and reducing disability. The problem with this approach is that impairment does not necessarily correlate to disability or handicap [8, 22]. Improving wrist extension, for example, may not transfer to the efficient use of cutlery when eating. Tremayne et al. [18] found a weak and non-significant correlation between the range of motion and activity after distal radius fractures. The clinician therefore needs to consider the significance of an impairment focus to the patient. Perhaps the primary focus of treatment should be to restore

optimal activity to the patient [4, 6]. This would appear to be a more meaningful outcome to the patient. A treatment approach that is activity focussed has not been documented in the literature in populations with distal radius fractures. The one study located to have reported activity outcome in this population [20] concluded that physiotherapy did not assist in the return of functional activity. One concern with the interpretation of these results is that activity outcome was assessed using a scale with no reported measurement properties [16]. Recently a scale to measure activity limitation has been developed and validated on a population with fracture of distal radius [8, 9].

The aim of this research was to measure the activity change of patients with distal radius fractures following an activity-focussed course of treatment, i.e. an assessment and treatment approach that focuses on restoring optimal motor performance of activities that were limited. Outcomes were compared with patients receiving a single session of advice and exercise administered by a physiotherapist, using a scale to measure the activity limitation that has been validated in people with a fracture of distal radius.

Method

Patients with distal radius fractures managed conservatively in cast were recruited for the trial. Eligibility to participate included removal of cast, an age of 18 years and over, an ability to understand written and spoken English and willingness to participate. Exclusion criteria included signs or symptoms of complex regional pain syndrome [19], documented evidence of psychiatric disorder, a pre-existing upper limb inflammatory joint condition, external or internal fixation in situ (apart from K wire), refracture of distal radius or concurrent upper limb fracture requiring medical management.

Patients were recruited from a metropolitan hospital fracture clinic on the day of the removal of cast. Randomisation was via concealed envelopes. The participant after gaining consent was asked to randomly choose a sealed envelope. This envelope contained a predetermined allocation into one of the two groups, activity-focussed physiotherapy or a single session of advice from the physiotherapist.

Outcome measures

Outcome measures included measures of activity and measures of impairment. Activity was represented by the Patient-Rated Wrist Evaluation (PRWE) [8, 9]. The questionnaire comprises five pain items, six activity items and four disability items. An 11-point scale is incorporated into each question. The three subscales are scored either separately or collectively as percentages. A higher score represents a poorer outcome. It was brief and easy to administer.

Range of movement was measured for wrist flexion and extension [7] and grip strength was measured using a Jamar dynamometer serial no. 10312593 (Preston, Clifton, NJ, USA), standardised on the second setting to ensure maximal grip strength [2]. Three measures were taken for each range of motion and grip measurements with the scores being averaged from the second and third measures and the first being regarded as familiarisation. This was done since it was observed that the first was systematically and significantly different from the second and third measures.

Outcome measures were obtained by an independent examiner, blind to the group allocation and experienced in musculoskeletal assessment at baseline, 6 and 24 weeks following removal of cast.

Intervention

All patients were taught routine exercises by the physiotherapist on the day the cast was removed. These exercises focussed on encouraging return of active movement to the wrist. Those allocated to the single session of exercise and advice returned within the week for clarification of exercises from the physiotherapist. Those allocated to the activity-focussed physiotherapy group attended physiotherapy regularly for up to 6 weeks. The total number of sessions attended by these subjects was based on the clinical judgement of the treating physiotherapist in consultation with the subject. This was usually at a time of return to regular wrist activity.

Activity-focussed physiotherapy was defined as an assessment and treatment approach that focussed on restoring optimal motor performance of activities that were limited. Components of skill acquisition such as task-specificity training, feedback, practice and modification of task environment were principles utilised in the programme. Where impairments affected the execution of the task they were addressed using manual therapy and exercise concurrent to the practicing of the activity. If the skill needed to be broken down into its individual components this practice was adopted prior to the practice of the total task according to the principles of motor learning [1].

Data analysis

Sample size calculation was based on an effect size of $d = 1.0$ for change in grip strength after physiotherapy [21], allowing for a significance level of 0.05 and a power of 0.80. It was estimated that at least 18 participants would need to be allocated to each group for a sufficient power to detect change in activity, which is correlated ($0.51 < r < 0.76$) with grip strength in this population [18].

Baseline characteristics were compared in the two groups using Fisher's exact test or independent t tests, as appropriate. The interaction effect of the two-way

analysis of variance with one repeated factor (time) and one independent factor (time) was used to compare the groups for change from baseline to 6 weeks and from baseline to 24 weeks. To evaluate the effectiveness of the intervention, intention to treat analysis was used, by the carry-forward method for missing data, which assumes that any missing data remained constant [3]. To evaluate the efficacy of the intervention the analysis was repeated for participants who completed the intervention and testing.

Results

The trial profile can be viewed in Fig. 1. Thirty-five of the participants allocated completed the intervention and were tested at 6 weeks. There were four withdrawals from the single-session group and two withdrawals from the physiotherapy group. A further two participants did not complete the 24-week follow-up assessment. There were no adverse events related to either intervention. Participants in the physiotherapy group attended on average 4.4 (SD 2.3) treatment sessions compared with 0.9 (SD 0.4) sessions in the control group.

There were no significant differences between the two groups for age, gender, wrist injured, days of immobilisation or fracture classification type including the numbers that were K-wire transfixed (Table 1). There were also no significant differences between the groups for baseline measures of activity and impairment (Table 2). The details and baseline measures of the six

Fig. 1 Trial profile

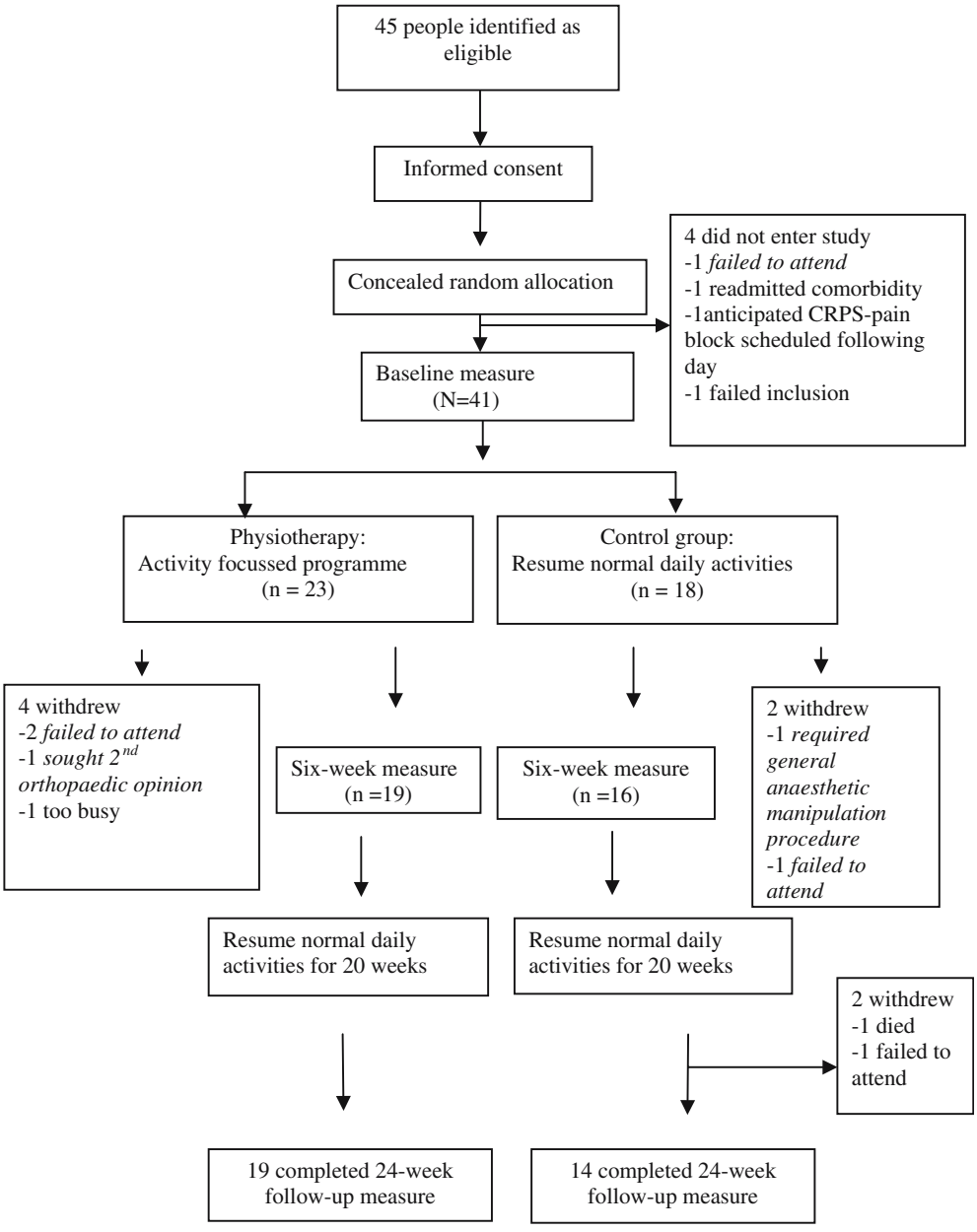

Table 1 Participant characteristics

	Physiotherapy ($n=23$)	Control ($n=18$)
Age (years)	55.7 (17.7)	55.8 (19.4)
Gender	4 males 19 females	6 males 12 females
Wrist injured	12 dominant 11 non-dominant	9 dominant 9 non-dominant
Immobilisation period (days)	44.6 (5.6)	42.5 (4.3)
AO classification	$A=16$ A21: 5 A22: 1 A23: 1 A31: 6 A32: 2 A33: 1	$A=13$ A21: 2 A22: 4 A23: 1 A31: 6
	$B=1$ B11: 1	$B=0$
	$C=5$ C1: 1 C11: 1 C12: 1 C21: 1 C22: 1 Unclassified: 1	$C=5$ C11: 1 C12: 2 C13: 1 C2 : 1
K-wire fixation	3	4

Means and standard deviations denoted in parentheses
AO Fracture classification where *A* denotes extra-articular, *B* denotes partial intra-articular and *C* denotes intra-articular [14]

participants who withdrew were not significantly different from those who completed testing at 6 weeks.

The results of the intention to treat analysis can be viewed in Table 2. There were no significant interaction effects for any of the outcome measures, so that one group did not improve more than the other immediately after the intervention at 6 weeks or at follow-up at 24 weeks. However, main effects for time were highly significant ($P<0.001$) for all comparisons, suggesting that both groups improved with time. When the analysis was repeated for treatment efficacy including only participants who completed the intervention and testing, there were again no significant differences between the groups in change between baseline and 6 and 24 weeks.

Discussion

There was no difference between the two groups for impairment measures, activity limitation and participation restriction both at baseline, 6 and 24 weeks following removal of cast. The severity of injury measured by the AO classification, age, gender, wrist injured and period of immobilisation in cast were not different between the two groups, so these factors could not account for any difference in outcome between the two groups. Despite the lack of difference between the groups both groups demonstrated a highly significant finding of improvement over time at both 6 and 24 weeks. The group receiving activity-focussed physiotherapy with an average of more than four consultations did not improve any more than the group that received physiotherapy in the form of a single session of advice and exercise prescription. These results suggest that there was no added benefit in the more intensive form of physiotherapy received by the activity-focussed group in this study, and that both groups appeared to have adequate returns of activity both at 6 weeks and certainly by 24 weeks after cast removal [9]. The number of physiotherapy treatments in our study (mean = 4.4) was similar to other studies reporting improvement in impairment with 3–5 physiotherapy treatments [20, 21] after fracture of the distal radius.

Previous research has demonstrated differences in impairment measures with more intensive physiotherapy treatment [20, 21]. This was not evident in this research. There are a couple of possible explanations for these differences. First, in the current study, a physiotherapist was the provider of treatment in both treatment groups. In contrast, Watt et al. [21] used a fracture clinic doctor rather than a physiotherapist to provide guidelines to the patient with a single session of

Table 2 Results

	Baseline		6 weeks		24 weeks	
	Physiotherapy ($n=23$)	Control ($n=18$)	Physiotherapy ($n=19$)	Control ($n=16$)	Physiotherapy ($n=19$)	Control ($n=14$)
Activity						
PRWE (%)	54.1(21.7)	59.4 (18.3)	26.9(24.0)	28.2 (20.6)	21.4 (24.5)	24.8 (22.2)
PRWE pain (%)	54.2 (21.1)	58.1 (19.5)	29.2 (23.4)	28.4 (19.2)	26.3 (25.4)	28.9 (21.3)
PRWE activity (%)	63.3 (28.9)	64.5 (25.0)	27.9 (28.2)	34.7 (28.2)	19.6 (29.4)	24.7 (26.4)
PRWE participation (%)	45.1 (28.2)	56.7 (26.0)	21.4 (24.1)	21.3 (24.3)	13.7 (23.9)	18.3 (25.0)
Impairments						
Grip strength (kg)	6.0 (8.3)	5.6 (6.7)	15.5 (11.6)	14.8 (8.1)	19.0 (14.0)	20.8 (11.1)
Wrist extension (degrees)	26.5 (14.1)	25.8 (17.2)	48.9 (15.9)	51.6 (16.5)	56.7 (16.5)	54.3 (14.4)
Wrist flexion (degrees)	29.3 (10.1)	32.8 (15.6)	42.7 (13.7)	46.9 (9.3)	50.7 (15.6)	51.3 (11.6)

Means and standard deviations denoted in parentheses. Figures in the table based on intention to treat analysis using the carry-forward method that assumes any missing data remained constant
PRWE Patient-rated wrist evaluation with 100% indicating reduced activity

exercise and advice. Physiotherapists are acknowledged for their expertise in movement analysis, exercise prescription and encouraging compliance. Perhaps the results in this current study would have been different if a physiotherapist did not conduct the single session of exercise and advice. Second, the treatment administered by the physiotherapists in the activity-focussed group concentrated on techniques to restore activity. This appears to be in contrast with much of the musculoskeletal physiotherapy practice where there has traditionally been a focus on treating impairments, e.g. restoring pain-free range of movement [11]. The lesser emphasis placed by the physiotherapists on restoring range of motion in this study might account for the differences in outcomes between this study and others [20, 21].

The trial differed from previous research in that a validated outcome measure for functional activity was used to assess outcome. Previous research on the effect of physiotherapy after distal radius fracture either did not assess activity limitation [21] or used a scale with unknown measurement properties [20]. The PRWE was the functional outcome measure used in this trial to measure pain, activity limitation and participation restriction. It was chosen for its qualities of validity, test–retest reliability, responsiveness to change and being user friendly in that it was easy to administer. A limitation in using this scale was that it did not evaluate compensatory mechanisms that the participants adopted in order to perform activity and participate. Also, this scale does not have a physical component of objective measurement of activities. It could be argued that compensatory strategies are not meaningful to the patient as they reflect an impairment that may not carry forward to activity limitation nor participation restriction. Physical objective measurements may be more meaningful to the practitioner rather than being of significance to the person with a fracture of distal radius.

In relation to subject withdrawal, the dropout rate at 6 weeks was 14.6% of the total population. This fulfils the PEDro quality assessment guidelines that at least one key outcome should be obtained from more than 85% of participants allocated to the groups [10]. At 24 weeks subject dropout was 19.6%. As the results of those who remained were no different to those who dropped out, the number of withdrawals is not likely to be significant for the interpretation of results.

Future directions in research could compare similar interventions in people with distal radius fractures that are managed via open reduction internal fixation or external fixation methods following removal of cast. It is possible that more severe fractures might be more amenable to more intensive physiotherapy. Also, research with a control group that receives no intervention might account for outcomes that could be attributable to the passing of time alone. There are ethical issues, however, in accounting for this situation.

Conclusion

The recommendation for managing patients with distal radius fractures that are conservatively managed is that they do not require anything more than a single session of exercise and advice provided by a physiotherapist. This is a beneficial outcome to the patient in reducing therapy time and cost of travel. There are also economic savings to the organisation in resource allocations to physiotherapy.

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