**Maintained physical activity and physiotherapy in the management of distal arm pain – a randomised controlled trial**

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**ABSTRACT**

*Objectives*

The epidemiology of distal arm pain and back pain are similar. However, management differs considerably: for back pain, rest is discouraged, whereas patients with distal arm pain are commonly advised to rest and referred to physiotherapy. We hypothesised that remaining active would reduce long-term disability; and that fast-track physiotherapy would be superior to physiotherapy after time on a waiting-list.

*Methods*

Adults referred to community-based physiotherapy with distal arm pain were randomised to: advice to remain active while awaiting physiotherapy (typically delivered after 6-8wks); advice to rest while awaiting physiotherapy; or immediate treatment. Intention-to-treat analysis determined whether the probability of recovery at 26wks was greater among the active advice group, compared with those advised to rest; and/or among those receiving immediate versus usually-timed physiotherapy.

*Results*

538 of 1663 patients invited between Feb-2012 and Feb-2014 were randomised (active = 178; rest = 182; immediate physiotherapy = 178). 81% provided primary outcome data; and complete recovery was reported by 60 (44%), 46 (32%) and 53 (35%), respectively. Those advised to rest experienced a lower probability of recovery (odds ratio: 0.54; 95%CI: 0.32-0.90), versus advice to remain active. However, there was no benefit of immediate physiotherapy (0.64; 0.39-1.07).

*Conclusions*

Among patients awaiting physiotherapy for distal arm pain, advice to remain active results in better 26wk functional outcome, compared with advice to rest. Also, immediate physiotherapy confers no additional benefit in terms of disability, compared to physiotherapy delivered after 6-8wks waiting time. These findings question current guidance for the management of distal arm pain.

*Key words*

Distal arm pain | Physiotherapy | Advice | Randomised trial

**INTRODUCTION**

Upper limb pain is common among working-aged adults: one UK study demonstrated a one-year period prevalence of pain lasting >1 day of 48%, amongst whom one-third had sought healthcare.1 The UK Health and Safety Executive estimated that 4million working days were lost because of work-related upper limb disorders in Great Britain in 2016/17.2 However, epidemiological investigations have been hampered by the lack of an agreed classification for upper limb disorders and the plethora of tautological terms implying causation including ‘repetitive strain injury’, ‘occupational cervico-brachial disorders’ and ‘work-related upper limb disorders’. More recently, with more consensus over case definitions,3;4 epidemiological studies of distal arm pain have found that both mechanical exposures (carrying weights, working with hands above shoulder height, bending/straightening the elbow, repetitive movements of the hand/wrist) and psychosocial factors (lack of job control, monotonous work, job dissatisfaction, negative beliefs, low expectation of recovery) were associated.5;6

Amongst those referred to physiotherapy with distal arm pain – i.e. pain in the elbow, forearm, wrist or hand – around 50% still report pain at 1yr, with a substantial minority reporting that symptoms are unremitting.7 Interestingly, although conventional teaching would suggest that distal arm pain is caused by specific conditions (epicondylitis, tenosynovitis, de Quervain’s, carpal tunnel syndrome) or may be non-specific, there is little evidence of any difference in prognosis amongst these groups 1yr after physiotherapy referral.7

Thus, the evidence suggests that distal arm pain is common, disabling, and has mechanical and psychosocial aetiology, and there is little evidence that separating states of ‘disease’ with different presumed causation or risk factors results in different therapeutic outcomes. In many respects, therefore, distal arm pain is similar to mechanical low back pain, the management of which was transformed when evidence emerged that bed rest was ineffective, and that patients experienced improved outcomes if they maintained activities.8 Education and large-scale health campaigns9 practice has changed and today, unless there are red flags, few are sent for imaging, receive specific diagnoses, or are advised to rest. In contrast, with the exception of specific treatments for some certain underlying pathologies (e.g. decompression for carpal tunnel syndrome), rest is the most prescribed recommendation in the management of distal arm pain, with the use of analgesics or anti-inflammatories as required, and referral for physiotherapy for persistent symptoms. Guidance from the UK National Health Service (NHS) website recommends that for tendonitis and tennis elbow, it is important to rest the injured limb and stop doing the exercise or activity that caused the symptoms;10;11 and the UK Health and Safety Executive advises that ‘if a task is causing or contributing to an upper limb disorder, the worker may need to stop doing that task for a time’.12 This guidance is based upon the biomedical assumption that the tissues have been ‘injured’, and that the treatment of choice is therefore avoidance, even though there is no published evidence to support this assumption.

Written information providing evidence-based advice (The Back Book) is effective in promoting positive beliefs and contributing to improved clinical outcomes in back pain.13;14 It is plausible therefore that patients with distal arm pain could benefit from a similar approach. We conducted a randomised controlled trial to test the hypothesis that, among patients referred for physiotherapy with an episode of distal arm pain, advice to remain active and maintain usual participation results in a long-term reduction in disability, compared with advice to rest. Within the same trial, we also tested the hypothesis that, among patients referred for physiotherapy with an episode of distal arm pain, fast-track treatment would result in reduced long-term disability, as compared with treatment delivered after routine NHS waiting times.

**METHODS**

**Design**

We conducted a multi-centre, three-arm, randomised controlled trial. The study was registered on [www.controlled-trials.com](http://www.controlled-trials.com) (reference: ISRCTN79085082) and its full protocol has been published.15 The study was approved by the UK South Central (Hampshire A) Research Ethics Committee (reference: 11/SC/0107).

**Patients**

Participants were recruited from 14 National Health Service primary care physiotherapy referral centres, across the UK. Patients (aged ≥18yrs) were potentially eligible for study if they were newly referred for out-patient physiotherapy with distal arm pain or disability. They were excluded, however, if: they had received physiotherapy for distal arm pain within the past twelve months; the distal arm was not the main focus for treatment (e.g. the pain was thought to originate from pathology in the neck); the pain was due to a fracture, systemic inflammatory disease, cancer, or complex regional pain syndrome; symptoms were due to a specific disorder for which advice to remain active was contraindicated (e.g. florid tenosynovitis); the appointment was classed as an emergency; and/or they were involved in a legal dispute regarding their arm problem.

Potential participants were identified from out-patient clinic referrals and sent an invitation letter by a local research nurse, followed by a reminder if they failed to respond. Those who indicated that they might be willing to participate were invited to attend a pre-trial screening visit to confirm their eligibility. At the visit, patients completed a questionnaire that asked about demographic characteristics, employment, symptom history, disability caused by the arm problem, and other factors thought to be important potential prognostic markers, or modifiers of treatment response. These included general health, physical and mental well-being, other symptoms (headache/abdominal pain/chronic widespread pain), somatic distress, and health beliefs (especially fear avoidance). Patients also underwent a structured examination for the purposes of diagnosis and classification – the Southampton Examination Schedule for Upper Limb Disorders.16 This examination, involving inspection, palpation and clinical provocation tests, has previously been validated for out-patient and community settings, and applied in large-scale epidemiological studies,17 and all research nurses were trained in the conduct of the examination by two of the investigators who originally developed and validated the examination schedule.

**Consent**

Patients provided written informed consent before completing the baseline (screening) questionnaire and physical examination. They were also asked to give consent for randomisation should they prove to be eligible and this was reconfirmed, verbally, immediately prior to randomisation.

**Randomisation**

Randomisation was conducted by the Robertson Centre for Biostatistics, University of Glasgow (part of the UK Clinical Research Collaboration registered Clinical Trials Unit) and was performed online, with telephone back-up. Patients were allocated to one of the three treatment groups, using a mixed randomisation and minimisation algorithm to maintain treatment balance with respect to treatment centre, laterality (dominant, non-dominant, bilateral), a broad categorisation of diagnosis (predominant problem in the elbow, versus wrist/hand), and baseline arm function, as assessed using a modified-DASH score (the primary outcome measure, see below, with scores grouped as 0-5, 6-8, or 9-11). One-third of patients were allocated completely at random, whilst two-thirds were allocated according to the minimisation algorithm. Randomisation to the three groups, or entry to the minimisation procedure, was determined according to a pre-specified allocation schedule generated using the method of randomised permuted blocks of nine participants. Within the minimisation algorithm, any ties between treatment groups (i.e. where allocation to more than one group would provide an equally low level of imbalance), were resolved by assigning the patient at random to one of the tied treatment groups. In terms of allocation concealment, as a consequence of their login permissions on the database, researchers from any one site were blind to data (and, thus, all randomisation information) from all other sites. Within each site, in order for an individual to guess which allocation was coming next, they would need to know the minimisation data for all previously allocated patients. Even then, they would be unable to determine whether the next patient was going to be allocated according to the minimisation algorithm, or at random.

**Treatment**

Participants were randomised to one of:

1. Advice to remain active while awaiting usual care (waiting-list) physiotherapy;
2. Advice to rest while awaiting usual care (waiting-list) physiotherapy; or
3. Immediate physiotherapy.

Participants randomised to advice to remain active received a seven-page booklet on how to deal with arm pain: ‘*Keep Active to Recover Quickly*’.18 The booklet was biopsychosocial in nature and developed from the findings of a contemporary Health and Safety Executive Research Report.19 It presented the core message that distal arm pain is common, lasting damage is rare, and that recovery can be expected. In addition, it advocated a self-management approach with advice that early return to work and gradually increasing activity is helpful. The booklet was given to participants immediately post-randomisation, by the research nurse who conducted the screening/randomisation.

Participants randomised to advice to rest received a different booklet, designed to be similar in length and appearance. It was based on information available from the National Health Service at the start of the trial: ‘*Advice and Guidance on Arm Pain – Causes, Diagnosis, Treatment’*.18 It adopted a firmly biomedical approach, advocating rest and avoidance of activities that might further aggravate symptoms.

Participants randomised to immediate physiotherapy received an out-patient appointment at their earliest convenience. The trial was intended to be pragmatic in the delivery of physiotherapy, insofar as it reflected usual clinical care. However, to ensure that treatment programmes were compliant with both the Medical Research Council’s and the CONSORT organisation’s guidance on developing complex interventions, we conducted a review of national and international treatment guidelines to ascertain current best practice. Therapists were presented with a summary of this review, but were able to treat patients on an individual basis with no restrictions on the number of appointments, or treatment modalities. Thus trial participation influenced *when* physiotherapy commenced, but not which specific therapeutic interventions were delivered.

Patients who were allocated to either of the advice groups were subsequently invited to attend physiotherapy, as per usual care, after a normal interval on a waiting-list. At the start of the trial, this wait was approximately 6-8wks. Physiotherapists delivering their care received the same guidance on current best practice.

**Outcomes**

Reflecting a move away from pain as the primary outcome in many pain trials, and the concept that function is a more meaningful end point, the primary outcome was a complete absence of disability at 26wks post-randomisation, as assessed using a modified version of the DASH (Disabilities of the Arm Shoulder and Hand) questionnaire. The modified instrument was considered superior to the original for a number of reasons. For example, the original questionnaire contains no items that are specific to the distal arm, or that refer to activity limited specifically by pain. The modified instrument (mDASH) asked whether participants had experienced difficulty (yes/no/not applicable) with any of a list of 11 activities over the past seven days, because of an ‘ache or pain in the elbow, forearm, wrist or hand’, and has previously been used in large scale epidemiological studies of distal arm pain.7

The mDASH was assessed by postal questionnaire 26wks after randomisation with postal reminders to non-responders. Outcome data were also collected, in the same manner, at 6 and 13wks post-randomisation. Participants who did not return a questionnaire were contacted by telephone for verbal completion of the instrument.

Participants were also asked about behaviours and beliefs, so that the impact of advice could be assessed, and economic outcomes (costs associated with healthcare resource use including distal arm related hospital admissions, out-patient attendance and visits to/from relevant health professionals, and health-related quality of life measured by EQ5D and SF12 questionnaires) were assessed.

**Sample size and statistical analysis**

Previous studies have found that, among persons with distal arm pain receiving usual care (advice to rest, followed by physiotherapy), 51% reported being free of disability at 26wks.7 The current trial was powered on the assumption that, among participants who received advice to remain active followed by physiotherapy, this would increase to 70%. We required 148 subjects, per group, to detect this difference with 90% power at a 5% level of significance. From our experience of trials in other pain conditions20 we anticipated a 20% loss to follow-up and, thus, we aimed to assign 185 patients per group. In addition, we aimed to allocate a further 185 patients to immediate physiotherapy – i.e. a total of 555 randomised participants.

The primary analysis determined, at 26wks post-randomisation, (a) whether participants who received advice to remain active were more likely to be free of disability, compared with those advised to rest; and (b) whether those randomised to immediate physiotherapy were more likely to be free of disability, compared with those who received physiotherapy after a period on a waiting-list. A mixed effects logistic regression model was used to estimate the odds ratio for full recovery (mDASH=0) between different treatment groups. The model included treatment group (as a three-level categorical variable); age; gender; study centre; pain location (elbow, wrist/hand, or both); laterality (dominant, non-dominant, or bilateral); and baseline function (mDASH: 0-5, 6-8, or 9-11). The method of recycled predictions was used to estimate the absolute difference in the probability of being fully recovered between groups (advice to remain active versus advice to rest; and immediate versus usually timed physiotherapy). The model used for the primary analysis was used to work out the predicted probability of the outcome for each individual in the study, based on the baseline characteristics of the individual as well as treatment allocation. Thus, we estimated the probability of full recovery for each individual in the study, under the assumption that all received a single treatment and compute the average (mean) predicted probability for the study population under this treatment. When repeated for each treatment group, giving the overall probability of full recovery under each treatment (and the absolute differences between them). Confidence intervals were then computed using 1000 bootstrap samples.

All analyses were by intention-to-treat, and pre-planned sensitivity analyses were conducted, making different assumptions about participants with missing data for the primary outcome: that all had fully recovered; and that none had fully recovered.

A pre-specified analysis was conducted to examine any evidence of heterogeneity of treatment effects, through the use of terms for interactions between treatment and each of the other variables in the regression models.15

Although the primary outcome treated the mDASH score dichotomously – i.e. number of functional limitations at 26wks, none versus any – a pre-planned secondary analysis considered the mDASH score as a continuous variable. A linear regression model was fitted, adjusting for the same factors as previously. This model was used to estimate the difference in mean mDASH scores between those randomised to receive advice to remain active and those advised to rest, and also those randomised to immediate physiotherapy and those randomised to usual care physiotherapy – for which the mean mDASH score was taken as the average of the two advice groups. Results were summarised as the mean differences in scores between the three treatment groups after adjustment for the covariates in the models.

Finally, we conducted a 26wk within-trial economic evaluation (cost-utility analysis, where benefits are measured in terms of quality adjusted life years (QALY)s) from a UK health sector perspective. Assessments of the cost-effectiveness of alternative treatments are expressed as incremental cost-effectiveness ratios. Here, the health economic analysis will only be presented briefly, but full details of the economic evaluation methods and results are reported in a separate paper.21

**RESULTS**

Between February 2012 and February 2014, 1663 patients were invited to pre-trial screening, among whom, 680 were assessed for eligibility, and 538 were randomised: 178 to advice to remain active; 182 to advice to rest; and 178 to immediate physiotherapy; Figure 1). The mean (SD) age of participants was 49 (14) years and 46% were male. 29% of participants reported pain/disability in their elbow, 34% in their wrist/hand, and 37% in both. According to the Southampton Examination Schedule, 67% had a specific disorder, while 33% had non-specific symptoms. Lateral epicondylitis, tenosynovitis and thumb osteoarthritis made up nearly two-thirds of the specific diagnoses recorded (23%, 21%, and 17% respectively). Table 1 shows the demographic and baseline characteristics of the randomised participants, by treatment group.

At 26wks, 81% of participants provided primary outcome data (Figure 1) with similar proportions between treatment groups: 136 (76%), 134 (82%) and 152 (85%) in the advice to remain active, advice to rest, and immediate physiotherapy groups, respectively, of whom 60 (44%), 46 (32%) and 53 (35%) reported full recovery. Figure 2 (Panel A), illustrates the proportion of respondents at each time point with no disability (mDASH=0). This increased from 3.3% at baseline to 37% at 26wks. Figure 2 (Panel B) shows the prevalence of complete recovery in the three treatment groups at different stages of follow-up. Differences at 6 and 13wks were small, but at 26wks, the probability of full recovery was 45.1% among participants who received advice to remain active, compared with 32.2% among those who received advice to rest; a difference of 12.9% (95%CI: 2.3%, 23.7%) (Table 2). This equates to an odds ratio for full recovery at 26wks of 0.54 (95%CI: 0.32, 0.90) for advice to rest, versus advice to remain active. In contrast, there was no significant difference in the probability of full recovery at 26wks between participants randomised to immediate (35.8%) as compared with routinely timed physiotherapy (38.6%), a difference of -2.8% (-11.3%, 6.5%). The adjusted odds ratio for full recovery at 26wks was 0.64 (0.39, 1.07) for immediate physiotherapy, versus advice to remain active. Sensitivity analysis, making different (pre-specified) assumptions about the prevalence of full recovery at 26wks and, separately, excluding participants who provided follow-up data by telephone, did not alter these conclusions (Table 2).

There was no clear evidence of an effect in the early part (≤13wks) of the follow-up period from advice to remain active (Figure 2). The differences in the probability of full recovery at 6 and 13wks, in comparison with those who received advice to rest, were 0.3% (-6.4%, 6.8%) and 3.1% (-6.7%, 12.0%), respectively (Table 3). Similarly, there was no evidence of short-term benefit from immediate physiotherapy, versus usually timed treatment, differences in the probability of full recovery being -0.4% (-6.4%, 5.3%) and -1.6% (-9.5%, 5.9%) at 6 and 13wks respectively. While patients were more than five times more likely to report full recovery at 26wks than 6wks (odds ratio 5.31; 3.86, 7.31) there was no evidence of a time-by-treatment interaction (p=0.750).

There were indications of a gender-by-treatment interaction (p=0.047) such that, compared to men randomised to advice to remain active, those randomised to either of the other two groups were less likely to report full recovery at 26wks, whereas this did not apply in women (Figure 3). Although there were other minor differences between sub-groups, there were no other large or statistically significant interactions between treatment group and the other variables in the final model.

While the proportion of participants reporting full recovery at 26wks differed between treatment groups, no significant difference was observed in mean mDASH score between those who received advice to remain active and those advised to rest (-0.50; -1.13, 0.13), or between those who received immediate as compared with normally timed physiotherapy (0.24; -0.29, 0.78).

**Cost-effectiveness**

The number of treatment sessions was similar between treatment groups (Table 4), indeed the difference in mean NHS costs between the three groups was small, and not statistically significant. Adjusted mean cost differences were £88 (-£14, £201) for advice to remain active versus advice to rest, and -£14 (-£87, £66) for immediate versus normally timed physiotherapy (Table 5). The differences in mean QALYs were also similar between treatment groups: adjusted mean QALY differences were 0.0095 (-0.0140, 0.0344) for advice to remain active versus advice to rest, and 0.0143 (-0.0077, 0.0354) for -£14 (-£87, £66) for immediate versus normally timed physiotherapy.

**DISCUSSION**

Among patients referred to physiotherapy with distal arm pain, we have demonstrated that advice to remain active is associated with better functional recovery at 26wks, compared with advice to rest. In addition, we have shown that physiotherapy delivered immediately offers no additional benefit in terms of disability at 26wks, compared to physiotherapy delivered after a 6-8wk waiting time.

Several methodological issues should be considered when interpreting these findings. Firstly, we expected that approximately half of participants would be symptom-free after 26wks, based on a previous study of distal arm patients recruited from primary care and physiotherapy.7 In fact, according to the primary outcome chosen for this study (complete absence of disability according (mDASH=0) after 26wks), the proportion of patients in any of the 3 arms who had fully recovered was lower than 50%. The original power calculation anticipated a 51% recovery rate in the group advised to rest. The primary analysis model predicted the recovery rate in this group to be 32.2%, thus the original target of 148 per group had 90% power to detect an increase to 51.5%. This absolute increase in recovery of 19.3% is comparable to the original sample size calculation, which gave 90% power to detect an absolute increase in recovery of 19% (from 51% to 70%). Given the achieved sample size for the primary analysis (N=136 and N=146 in the active and rest groups respectively) the study had 89% to detect an increase in recovery from 32.2% to 51.5%. Therefore we do not believe that our study was under-powered to detect important differences between groups.

Secondly, although we conducted intention to treat analysis, it is important to note that primary outcome data could not be obtained for 19% of participants. Importantly, sensitivity analyses, which assumed both of the extreme scenarios – that all or none of those with missing data had fully recovered – indicated that the main trial results were not critically influenced by the unavailable data.

Although patients were potentially eligible if they were referred to physiotherapy with pain and/or disability in the distal arm, referral letters were not available, and it is not known how many participants were referred with pain, disability, or both. However, at the point of randomisation, 458 (85%) reported pain and disability; 62 (12%) disability but no pain; 17 (3%) pain but no disability; and one neither (but was randomised nonetheless, because the eligibility criteria applied at screening and initial invitation.) Treatment allocation was similarly balanced between these four groups and, in the two groups reporting disability at baseline, the proportion achieving the primary outcome was comparable: 36% and 32% respectively. Interestingly, of those without disability at baseline, around one-quarter had disability at 26wks.

Follow-up questionnaires were required at 6wks, 12wks and 26wks. However, anticipating some non-response, we also obtained ethical approval to contact non-responders (after a postal reminder) by telephone to collect more limited follow-up data. Our follow-up response rates were much as expected, but over 26wks, there was an increase in the proportion of responders who provided outcome data by telephone, with small (although non-significant) differences between groups (Figure 1). Importantly, post hoc analysis, restricted to questionnaire respondents, revealed similar findings to the main analysis (Table 2) and did not call into question the validity of conclusions based on the main analysis.

The pre-stated outcome was complete recovery from disability,15 and with this outcome advice to remain active was clearly superior to advice to rest. However, when the mDASH was analysed as a continuous variable, the difference between the advice groups, although in the same direction, was not statistically significant (difference in mean mDASH score between active versus rest advice groups: -0.50 (-1.13, 0.13). One can speculate the reasons for this, although it may be that mean values for the mDASH were strongly influenced by a small minority of participants with relatively high scores, making it harder to demonstrate statistical significance.

This study was predicated on the assumption that distal arm pain might be similar to mechanical low back pain – both are common and disabling, have similar profiles of risk factors with little evidence that, amongst those referred for physiotherapy, separating different ‘diseases’ had led to any differences in prognosis.22 The superiority of avoiding rest in back pain management was first demonstrated >20yrs ago, but rest continues to be widely advocated in the immediate management of distal arm pain under the beliefs of a biomechanical causation.10;11 Our results provide evidence that, amongst this group of patients, as for back pain, advice to rest may not be the best approach. The content of the experimental leaflet gave reassurance, explained that often there is no obvious cause of injury, promoted the maintenance of activity, and advised early return to work. Our study could not inform as to whether the advice leaflets were read or not. However, it is interesting to note that at 6wks post-randomisation, 50.5% of those in the ‘active’ advice group reported that they were trying to be more active than when their pain had first started, compared to only 29.9% of those advised to rest (difference: 20.6%; 95%CI: 8.0%, 33.1%). This differential was maintained at 13wks (47% versus 32%), but was no longer apparent at 26wks (49% versus 45%). Although not conclusive, this is consistent with the hypothesis that the positive outcome seen at 26wks was built on early changes in health behaviour and/or associated health beliefs. Alternatively, it may be that keeping active during the initial waiting-list period enables participants to derive more benefit from physiotherapy when they receive it. This would also explain the fact that the divergence in effect is seen at 13wks (i.e. after advice, and after physiotherapy). It would have been interesting to have objectively measured activity levels, but this was not feasible in the current study. It would be naïve to assume that all participants adhered perfectly to the advice they were given. However, lack of adherence would tend to bias the findings towards the null hypothesis – i.e. more likely to find no differences between groups, and the fact that a difference was observed even more remarkable.

A small proportion of participants in the advice groups sought private physiotherapy, to obtain treatment sooner than was available via the NHS. If the proportion of patients doing this was greater among those advised to remain active, it might explain their better outcomes. However, a comparison showed that the rates of private physiotherapy were similar between advice groups (12% and 15% respectively) and therefore unlikely to explain the findings. Additionally, in confirmatory analyses in which those who took up private physiotherapy were excluded, the trial results were unaltered.

Because physiotherapy regimens were not specified in the study protocol, it might be feasible that there had been some systematic differences in the treatment given between groups, perhaps in the number of sessions or the treatment modalities employed. However, these data were recorded throughout the trial and we found no differences in the median number of treatment sessions between groups. While the frequency of physiotherapy sessions varied depending on centre and therapist, most participants were treated once per week until discharge, as one would expect in usual care – reflecting the pragmatic nature of the trial. A comparison of treatment modalities between those randomised to immediate or ‘waiting list’ physiotherapy revealed that those in the ‘immediate’ groups were more likely to receive ‘PRICE’ (Protection, Rest, Ice, Compression and Elevation), but this is to be expected since PRICE is recommended in response to acute pain. Indeed, the ‘immediate’ group, possibly as part of ‘Protection’, were more likely to be given an orthotic device. In interpreting these data however, there is no reason to expect that greater use of these modalities would detract from the benefits of early physiotherapy, and there were no other large, consistent, or statistically significant differences in treatment modalities between any of the three groups. For all groups, education and exercise were the most commonly recommended therapies.

Most participants had experienced symptoms for >1 month before recruitment. It is perhaps not surprising, therefore, that differences between the two advice groups did not emerge immediately, but rather were gradual, and only statistically significant at 26wks (the pre-specified primary end point). Although the difference was not great, a slightly smaller proportion of patients in the immediate group presented with a short duration of symptoms (≤ 1 month): 15% versus 22% in each of the advice groups, but, symptom duration was not associated with prognosis. We also found no evidence of heterogeneity of the effect of advice to remain active between participants with a specific versus non-specific diagnosis. This supports previous epidemiological work suggesting no difference in prognosis between those with specific/non-specific symptoms.7

The interaction between gender and treatment is intriguing. This (pre-specified) analysis was conducted to determine whether there was any evidence of heterogeneity of treatment effect, between treatment group and other variables in the final regression model, rather than because of any particular *a priori* clinical hypothesis. Women, at baseline, reported higher levels of disability than men, and the probability of full recovery was inversely proportional to baseline disability. It may be, therefore, that it was simply harder for them to reach full recovery after 26wks than it was for men. However, the explanation for this finding cannot be determined from the available data.

In summary, pain and disability in the distal arm is common. Although aetiological and prognostic factors are similar to those for low back pain, hitherto, its management has been very different. Rest is rarely advised for back pain but is commonly recommended for patients with distal arm pain, despite the lack of any published evidence to support this management strategy. Our trial calls this approach into question, and provides the first evidence that advice to remain active is associated with superior clinical outcomes. Furthermore, we found no indication that earlier initiation of physiotherapy improved long-term clinical outcome. This has important implications for employers and their occupational health advisors, as well as for those working in primary care and physiotherapy. Although immediate physiotherapy was shown to be no more effective than physiotherapy delivered after a waiting list, it was no more costly. What is clear however is that the early management should encourage activity: this is more effective, in terms of six-month outcome, and also more likely to be cost-effective than advice to rest. Undoubtedly, further independent confirmation would strengthen our conclusions but there is unlikely to be additional randomised controlled trial data available. Therefore, based on the previous epidemiological data, an extensive evidence base about back pain, and from the current trial results, we recommend that, for the majority of cases, the most sensible course of action would be to stop advising that patients with distal arm pain rest, while awaiting physiotherapy.

**KEY MESSAGES**

1. Among patients referred to physiotherapy with distal arm pain, advice to remain active is associated with better functional recovery at 26wks when compared with advice to rest.
2. Among patients referred to physiotherapy with distal arm pain, physiotherapy delivered immediately offers no additional benefit in terms of disability at 26wks, compared to physiotherapy delivered after a 6wk waiting time.
3. This has important implications for employers and their occupational health advisors, as well as for those working in primary care and physiotherapy.

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The University of Aberdeen was the study sponsor and oversaw the running of the trial, but had no role in the study design or day-to-day conduct of the study.

*Author contributions*

The study was conceived and designed by GTJ, GJM, KTP and DC. KB was responsible for production of the advice material. KWB and CM were local principal investigators; KWB also trained research nurses in the Southampton Examination Schedule. PJH provided physiotherapy expertise, and developed guidance on the treatment of distal arm pain. GTJ was chief investigator of the study and oversaw study conduct with GJM, KWB, KB, PJH, CM, PM, AM, KTP and DC. The primary analysis was undertaken by RZ at the Robertson Centre for Biostatistics, University of Glasgow, under the supervision of AM, with additional analysis at the University of Aberdeen by DW, under the supervision of GTJ. GTJ produced the first draft of the manuscript and all authors provided intellectual input into its revision.

*Competing interests*

We have read and understood BMJ policy on declaration of interests and declare the following interests: Professor Kim Burton has been involved in the development of *The Arm Book* (ISBN: 978-0117069145), to which the experimental leaflet in this trial is related, and may receive future royalties on the booklet.

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*Clinical trial registration and ethical approval.*

The Trial was registered on [www.controlled-trials.com](http://www.controlled-trials.com) (reference: ISRCTN 79085082) and the National Institute for Health Research Clinical Research Network portfolio (reference: 11049), and received ethical approval from the UK South Central (Hampshire A) Research Ethics Committee, reference: 11/SC/0107.

*Data sharing*

Relevant anonymised patient level data are available on reasonable request from the corresponding author.

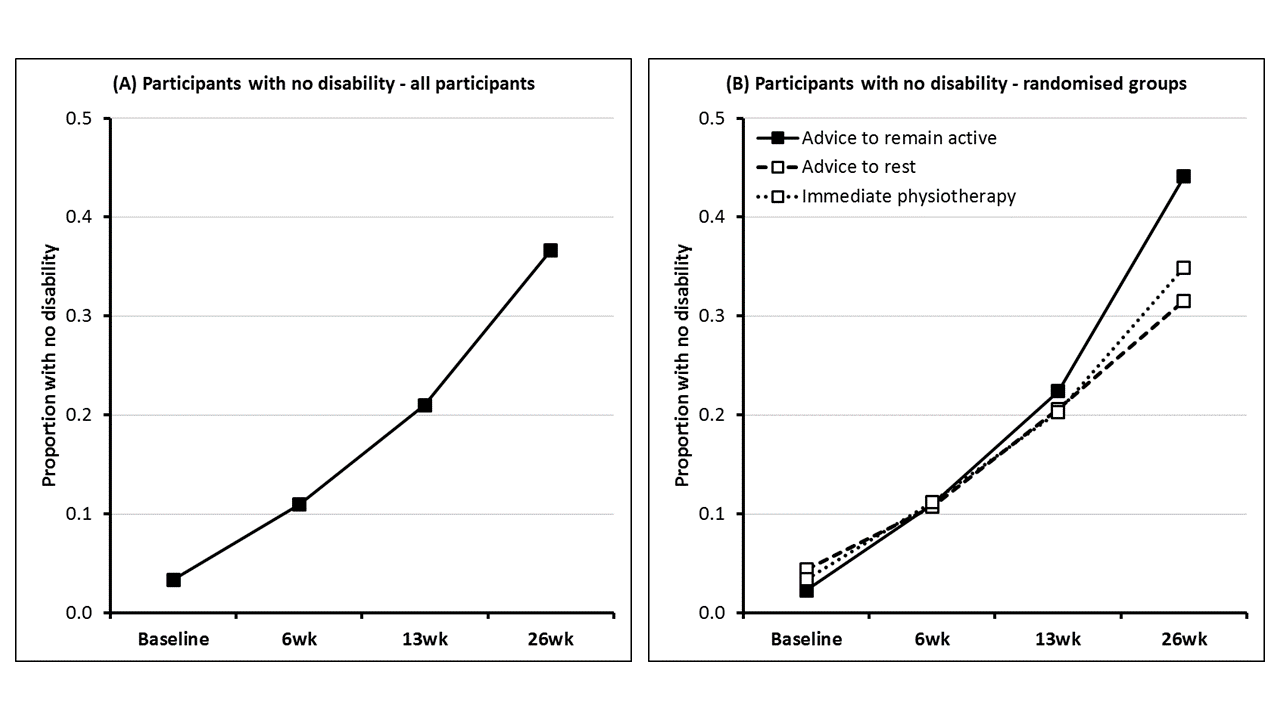
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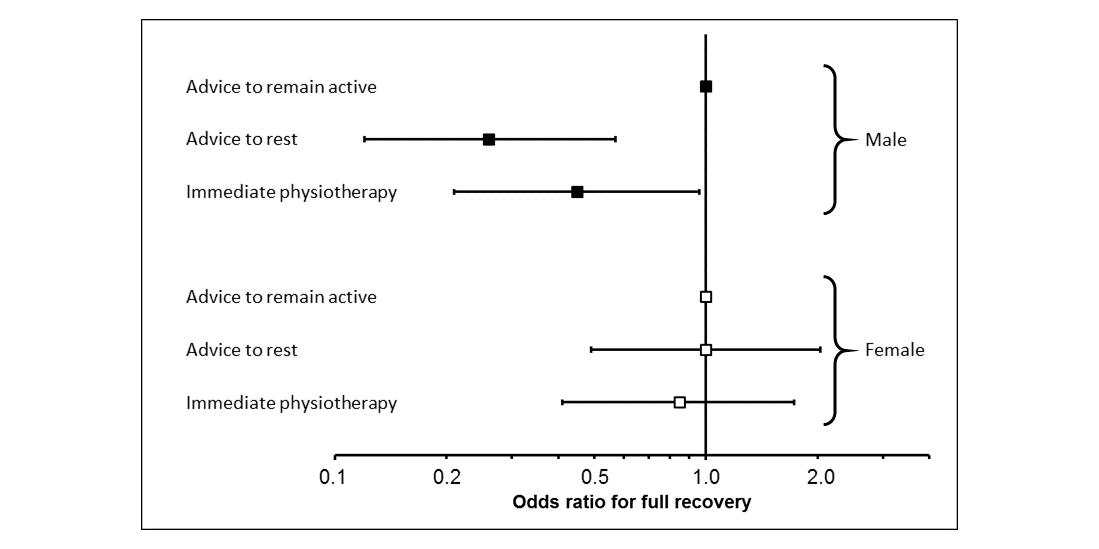
**FIGURE 1 CONSORT FLOW DIAGRAM**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  |  |  |  |  | Invited (potentially eligible) patients (N = 1663) | | | | | |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  | Non-response / Declined to participate (N = 983) | | | | | |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  | Assessed for eligibility  (N = 680) | | | | | |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  | Excluded1  (N = 142) | | | | | |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  | Randomised  (N = 538) | | | | | |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Advice to remain active  (N = 178) (33%) | | | | | | |  | Advice to rest  (N = 182) (34%) | | | | | |  | Immediate physiotherapy  (N = 178) (33%) | | | | | |
|  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Median (IQR2) days to physiotherapy: 45 (34.5-63.5) | | | | | | |  | Median (IQR2) days to physiotherapy: 47 (35-63) | | | | | |  | Median (IQR2) days to physiotherapy: 8 (6-14) | | | | | |
|  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | | 6wk follow-up | | | | |  |  | 6wk follow-up | | | | |  |  | 6wk follow-up | | | | |
|  | |  |  |  |  |
|  | |  | | | | |  |  |  | | | | |  |  |  | | | | |
|  | | Questionnaire response  (N = 110) (62%) | | | | |  |  | Questionnaire response  (N = 117) (64%) | | | | |  |  | Questionnaire response  (N = 134) (75%) | | | | |
|  | |  |  |  |  |
|  | |  | | | | |  |  |  | | | | |  |  |  | | | | |
|  | | Telephone response  (N = 37) (21%) | | | | |  |  | Telephone response  (N = 32) (18%) | | | | |  |  | Telephone response  (N = 18) (10%) | | | | |
|  | |  |  |  |  |
|  | |  | | | | |  |  |  | | | | |  |  |  | | | | |
|  | | Non-response  (N = 31) (17%) | | | | |  |  | Non-response  (N = 33) (18%) | | | | |  |  | Non-response  (N = 26) (15%) | | | | |
|  | |  |  |  |  |
|  | |  | | | | |  |  |  | | | | |  |  |  | | | | |
|  | | 13wk follow-up | | | | |  |  | 13wk follow-up | | | | |  |  | 13wk follow-up | | | | |
|  | |  |  |  |  |
|  | |  | | | | |  |  |  | | | | |  |  |  | | | | |
|  | | Questionnaire response  (N = 88) (49%) | | | | |  |  | Questionnaire response  (N = 97) (53%) | | | | |  |  | Questionnaire response  (N = 122) (69%) | | | | |
|  | |  |  |  |  |
|  | |  | | | | |  |  |  | | | | |  |  |  | | | | |
|  | | Telephone response  (N = 46) (26%) | | | | |  |  | Telephone response  (N = 49) (27%) | | | | |  |  | Telephone response  (N = 36) (20%) | | | | |
|  | |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | | Non-response  (N = 44) (25%) | | | | |  |  | Non-response  (N = 36) (20%) | | | | |  |  | Non-response  (N = 20) (11%) | | | | |
|  | |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | | 26wk follow-up | | | | |  |  | 26wk follow-up | | | | |  |  | 26wk follow-up | | | | |
|  | |  |  |  |  |
|  | |  | | | | |  |  |  | | | | |  |  |  | | | | |
|  | | Questionnaire response  (N = 80) (45%) | | | | |  |  | Questionnaire response  (N = 83) (46%) | | | | |  |  | Questionnaire response  (N = 105) (59%) | | | | |
|  | |  |  |  |  |
|  | |  | | | | |  |  |  | | | | |  |  |  | | | | |
|  | | Telephone response  (N = 56) (31%) | | | | |  |  | Telephone response  (N = 63) (35%) | | | | |  |  | Telephone response  (N = 47) (26%) | | | | |
|  | |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | | Non-response  (N = 42) (24%) | | | | |  |  | Non-response  (N = 36) (20%) | | | | |  |  | Non-response  (N = 26) (15%) | | | | |
|  | |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | Not eligible (N = 133) including 1 randomised in error, then subsequently excluded after they were found to be ineligible; and Unknown (N = 9) | | | | | | | | | | | | | | | | | | | |
| 2 | IQR = Inter-quartile range | | | | | | | | | | | | | | | | | | | |

**FIGURE 2 PROPORTION OF RESPONDERS WITH NO DISABILITY, AT EACH TIME POINT**



**FIGURE 3 IMPACT OF TREATMENT ON FULL RECOVERY AT 26 WEEKS, BY GENDER**



**TABLE 1 BASELINE CHARACTERISTICS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Selected baseline characteristics1** | | | **Advice to**  **remain active** | **Advice to**  **rest** | **Immediate physiotherapy** |
| **(N = 178)** | **(N = 182)** | **(N = 172)** |
| Age, mean (SD) | | | 49.1 (13.9) years | 50.3 (14.2) years | 48.2 (12.8) years |
| Gender (male) | | | 77 (43.3%) | 87 (47.8%) | 81 (45.5%) |
| Body mass index, mean (SD) | | | 27.3 (5.04) kgm-2 | 27.5 (5.25) kgm-2 | 27.1 (4.47) kgm-2 |
| Employment status | | Full-time work | 79 (44.4%) | 94 (51.9%) | 98 (55.4%) |
|  | | Part-time work | 39 (21.9%) | 28 (15.5%) | 29 (16.4%) |
|  | | Retired | 29 (16.3%) | 31 (17.1%) | 17 (9.6%) |
|  | | Other | 31 (17.4%) | 28 (15.5%) | 33 (18.6%) |
| Handedness | | Right | 155 (87.1%) | 154 (84.6%) | 162 (91.0%) |
|  | | Left | 18 (10.1%) | 17 (9.3%) | 13 (7.3%) |
|  | | Both | 5 (2.8%) | 11 (6.0%) | 3 (1.7%) |
| Broad diagnosis | | Elbow | 50 (28.1%) | 53 (29.1%) | 53 (29.8%) |
|  | | Wrist/hand | 61 (34.3%) | 62 (34.1%) | 58 (32.6%) |
|  | | Both | 67 (37.6%) | 67 (36.8%) | 67 (37.6%) |
| Specific problem2 | | Specific | 127 (74.7%) | 107 (60.5%) | 114 (66.3%) |
|  | | Non-specific | 43 (25.3%) | 70 (39.5%) | 58 (33.7%) |
| Laterality of problem | | Dominant | 80 (44.9%) | 83 (45.6%) | 81 (45.5%) |
|  | | Non-dominant | 54 (30.3%) | 55 (30.2%) | 52 (29.2%) |
|  | | Bilateral | 44 (24.7%) | 44 (24.2%) | 45 (25.3%) |
| Duration of problem | | ≤ 1 month | 38 (22.2%) | 38 (21.6%) | 26 (15.2%) |
|  | | > 1 month | 133 (77.8%) | 138 (78.4%) | 145 (84.8%) |
| Pain severity, median (interquartile range) | | Right side | 5 (1, 7) | 5 (2, 7) | 5 (2, 7) |
| Left side | 3 (0, 6) | 3 (0, 6) | 3 (0, 7) |
| Tampa Scale of Kinesiophobia, mean (SD) | | | 3.62 (5.60) | 3.67 (5.77) | 3.63 (5.99) |
| Baseline mDASH3 score, mean (SD) | | | 5.9 (2.8) | 5.8 (2.8) | 5.9 (2.7) |
| EQ5D health utility score, mean (SD) | | | 0.674 (0.222) | 0.667 (0.233) | 0.655 (0.224) |
| 1 | All data presented as N (%), unless otherwise specified | | | | |
| 2 | Numbers do not sum to randomised totals, due to missing data from clinical examination and, thus, an inability to classify all participants | | | | |
| 3 | On how many days in the past 7 days did you have pain in your elbow, forearm, wrist or hand? (0-10 numerical rating scale.) | | | | |
| 4 | Modified-DASH = modified Disabilities of Arm Shoulder and Hand questionnaire (the primary outcome) | | | | |

**TABLE 2 PROBABILITY OF FULL RECOVERY AT 26 WEEKS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | **Probability of full recovery at 26 weeks (95% confidence interval)** | | | |
|  | | **Main analysis** | **Sensitivity analysis1** | **Sensitivity analysis2** | **Sensitivity analysis3** |
| Advice to remain active | | 45.1% (37.3%, 53.0%) | 58.7% (51.9%, 66.0%) | 34.4% (27.7%, 41.5%) | 44.6% (34.1%, 54.8%) |
| Advice to rest | | 32.2% (24.4%, 39.7%) | 45.6% (37.8%, 52.9%) | 25.2% (18.4%, 31.7%) | 23.7% (14.3%, 33.1%) |
| Difference | | 12.9% (2.3%, 23.7%) | 13.1% (3.4%, 22.3%) | 9.2% (0.3%, 18.5%) | 21.0% (7.6%, 34.7%) |
| Immediate physiotherapy | | 35.8% (28.7%, 42.9%) | 44.7% (37.8%, 51.4%) | 29.6% (23.1%, 36.2%) | 33.2% (24.8%, 42.7%) |
| Normally timed physiotherapy | | 38.6% (32.8%, 44.2%) | 52.1% (46.7%, 57.7%) | 29.8% (24.3%, 34.8%) | 34.1% (26.9%, 41.3%) |
| Difference | | -2.8% (-11.3%, 6.5%) | -7.5% (-16.1%, 0.7%) | -0.2% (-8.3%, 8.1%) | -0.9% (-11.9%, 10.4%) |
| 1 | Assumes ALL participants with missing data at 26wks were fully recovered | | | | |
| 2 | Assumes NO participants with missing data at 26wks were fully recovered | | | | |
| 3 | Restricting analysis to follow-up questionnaire respondents only | | | | |

**TABLE 3 PROBABILITY OF FULL RECOVERY, AT 6 AND 13 WEEKS**

|  |  |  |
| --- | --- | --- |
|  | **Probability of full recovery (95% confidence interval)** | |
|  | **6 weeks** | **13 weeks** |
| Advice to remain active | 10.4% (5.7%, 15.2%) | 22.8% (16.3%, 30.0%) |
| Advice to rest | 10.1% (5.0%, 15.3%) | 19.7% (13.0%, 26.3%) |
| Difference | 0.3% (-6.4%, 6.8%) | 3.1% (-6.7%, 12.0%) |
| Immediate physiotherapy | 9.8% (4.9%, 14.9%) | 19.6% (13.5%, 26.0%) |
| Normally timed physiotherapy | 10.3% (6.7%, 14.0%) | 21.2% (16.2%, 26.0%) |
| Difference | -0.4% (-6.4%, 5.3%) | -1.6% (-9.5%, 5.9%) |

**TABLE 4 NUMBER OF PHYSIOTHERAPY TREATMENT SESSIONS, PER GROUP**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Median** | **Inter-quartile range** | **Range** |
| Advice to remain active | 3 | 2-4 | 1-14 |
| Advice to rest | 3 | 2-5 | 1-15 |
| Immediate physiotherapy | 3 | 2-5 | 1-12 |

**TABLE 5 MEAN OVERALL COSTS AND QALYS FOR THE THREE TREATMENT GROUPS (OVER 26 WEEKS)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | | **Mean (SD) NHS costs** | **Mean (SD) QALYs** | **Incremental mean Costs (95% CI)1** | **Incremental mean QALYs (95% CI)1** | **Mean ICER2 (£/QALY)** |
| Group1  Advice to remain active | | £309.91 (£321.45) | 0.372 (0.111) | -£87.87  (-£14.33, £200.83) | 0.0095  (-0.0140, 0.0344) | Group 1 versus Group 2:  £9,256 |
| Group 2  Advice to rest | | £223.15 (£225.39) | 0.366 (0.077) | – | – | – |
| Group 3  Immediate physiotherapy | | £221.46 (£220.54) | 0.388 (0.089) | -£14.22  (-£87.14, £66.01) | 0.0143  (-0.0077, 0.0354) | Group 3 versus Group 1 and 2  Group 3 dominant (cost per QALY gained < 0) |
| 1 | Adjusted for age, gender, work status, modified dash, EQ-5D health utility score, and NHS cost; and bootstrapped non-parametric 95% confidence interval | | | | | |
| 2 | Mean incremental cost-effectiveness ratio, adjusted for age, gender, work status, modified dash, EQ-5D health utility score, and NHS cost | | | | | |