A dynamic exercise programme to improve patients’ disability in rheumatoid arthritis: a prospective randomized controlled trial

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Introduction

RA is the most common inflammatory arthritis and affects roughly 0.4% of the Caucasian population [1]. The mechanisms of synovial inflammation remain unclear but often lead to progressive joint destruction and deformation. The subsequent impairment in range of motion, muscle strength, endurance and aerobic fitness adds up to serious loss of function, work disability, dependency, impaired social and family function, reduced quality of life or low self-esteem [2]. The impact of the disease in the medico-economic domain is critical and joint rehabilitation constitutes the cornerstone of physical therapy [2, 3]. During flares, pain obviously requires rest and gentle, passive, non-weight-bearing exercise. Dynamic exercise programmes (DEPs), which have been developed in other diseases such as chronic airway obstruction or coronary heart disease [4, 5] in order to reduce the patient’s handicap, are now being used for the rehabilitation of RA patients. Although there is no standardized design of DEP for patients suffering from RA, most of the programmes follow the recommendations issued by the American College of Sports Medicine for healthy individuals [6]. Exercise must lead to a 60% increase of predicted maximal heart rate over 20 min, at least twice a week to exhibit clinical positive effects (improvement of muscular strength and aerobic capacity). The scientific evaluation of DEP in this disease has led to conflicting results. In a recent literature review [7] of the nine randomized controlled studies evaluating DEP in RA [8–16], we have underlined the methodological bias limiting the interpretation of previous studies. These publications provide several lines of evidence for improvement in aerobic capacity and muscle strength but conclusions concerning functional ability, physical capacity, quality of life and structural damages could not be drawn. Therefore, we designed this single-blinded RCT in order to determine whether a standardized DEP could provide beneficial effects with regards to these above-mentioned parameters.

Patients and methods

Patients

In April 2004, patients registered in the various rheumatology departments of the Grenoble University Teaching Hospital who fulfilled the 1987 modified ACR criteria for RA [17] were screened for inclusion in the study as well as for demographic and disease-related parameters (Table 1). Every patient at inclusion was being treated with a DMARD. All participants gave written consent, prior to inclusion, according to the Declaration of Helsinki. Local medical ethics committee gave the ethical approval for this study (CCPRB Grenoble II, 11 December 2002). An ECG was performed for every patient and a consultation with a cardiologist was scheduled for all patients older than 45 years, with positive cardiovascular risk factors or with an abnormal ECG. Exclusion criteria were: treatment with >10 mg glucocorticoid per day, no or unstable DMARD regimen, disease activity score 28 (DAS 28) variation >1.2 in the past 3 months, an age <18 or >70 years and global functional status in RA class III or IV [18]. Patients unable to follow the educational programme or complete a questionnaire because of cognitive impairment, psychiatric disease or language difficulty were also excluded from this study. Inability to perform aerobic exercise or complete the 1-year follow-up because of health problems or socio-professional status also constituted exclusion criteria. Biological assessment at baseline included: complete blood count, ESR, CRP, RF, serum glutamic oxaloacetic transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), creatinine, serum calcium and ALP.

A sample size of 38 patients in the DEP group and 76 patients in the control group was required to detect an HAQ difference of 0.25 between both groups with 90% power and a significance level...
of 0.05. To compensate for an expected 20% dropout, we planned to include 48 patients in the DEP group and 96 patients in the control group. Unfortunately, we were not able to enrol enough patients and the sample size was limited to 50 patients, based on previous studies [9, 12–15].

Randomization procedure

The randomization process was carried out by an independent statistician who was not responsible for recruiting the patients, at a central location. Patients were randomly assigned to either a DEP or a conventional joint rehabilitation by means of sealed and opaque envelopes. Study observers remained unaware of study-group assignments throughout the trial.

Interventions

The DEP was consistent with the 1990 recommendations of the American College of Sports Medicine [6]. Three or four members of the medical staff (rheumatologist, physiotherapist or occupational therapist) took part in each session for 5 h a day during a 4-week period (Table 2).

During the first week, following a multidisciplinary meeting, knowledge of the disease and physical capacity were evaluated for each participant in order to design an individualized exercise programme. The second week of occupational therapy input focused on the influence of RA on daily activities. The occupational therapy programme in the third week included skill exercises and daily activities with increasing intensity (endurance and exercises against resistance). During the fourth week the exercises focused on office tasks.

The training programme was designed to improve muscle strength, flexibility, endurance and balance. Exercises for the upper and lower limbs were performed five times a week in a gymnasium (cycling, running or resisting pulley cord, 45 min/day) and in a hydrotherapy pool (60 min/day). During cycling, the heart rate was kept at 60–80% of the predicted maximal heart rate (220 – age). Resistance and intensity of exercise were designed after individual evaluation of each patient and modified according to pain and fatigue. Regular breaks and relaxation sessions were scheduled in order to improve pain tolerance and self-esteem. Each session was preceded by a ‘warm-up’ and followed by a ‘cool-down’. The patients were asked to keep a diary of their daily training.

Patients in the control group received a multidisciplinary programme with a rheumatologist, a physiotherapist, an occupational therapist, a social worker, a pharmacist and a psychologist. This 3-day intervention (~20 h) was designed to improve knowledge about disease pathogenesis, RA management and joint protection. Each training group consisted of four or five patients accompanied by relatives or friends. The following fields were covered during lectures: mechanisms of RA, benefits and limitations of drug therapy, psychological impact of the disease (first day); dietic counselling (second day); and use of splints, surgical perspectives and counselling on activities of daily living or work (third day). Patients benefited from a hydrotherapy session (for 45 min at 35°C) on the first day and relaxation exercises (45 min) on the second day. Physical exercises (45 min/day) aimed at preventing muscles from atrophy and tension. Each day ended with an individual discussion where disease-related problems were verbalized and possible solutions were offered. The training was completed by means of educational films or activities covering the aspects of the programme.

To standardize the delivery of interventions, written forms detailed the coaching process based on the French Rheumatology Society recommendations, and patients received an educational booklet. Three physiotherapists were trained to carry out the physical intervention.

Primary outcome

The primary outcome was the functional status evaluated by HAQ [19] at 1, 6 and 12 months. HAQ, whose total score ranges from 0 (no functional limitation) to 3 (dramatic functional impairment), was selected as the primary outcome measure because of its ability to measure the function of large and small joints by the patients’ multidimensional ability to perform activities of daily living. Its validity in assessing disability in RA is well established.

Table 1. Demographic, clinical and radiological characteristic of the population

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>DEP group (n=25)</th>
<th>Control group (n=23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± s.d., years</td>
<td>51.6 ± 8.3</td>
<td>56.3 ± 12.8</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>21 (84.0)</td>
<td>18 (76.0)</td>
</tr>
<tr>
<td>Disease duration, mean ± s.d.</td>
<td>10.5 ± 8.0</td>
<td>11.7 ± 8.2</td>
</tr>
<tr>
<td>Morning stiffness, mean ± s.d.</td>
<td>59.8 ± 7.5</td>
<td>55.7 ± 9.74</td>
</tr>
<tr>
<td>Completers, n (%)</td>
<td>25 (100)</td>
<td>20 (80)</td>
</tr>
<tr>
<td>Professional status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time job, n (%)</td>
<td>6 (24.0)</td>
<td>5 (21.7)</td>
</tr>
<tr>
<td>Part-time job, n (%)</td>
<td>6 (24.0)</td>
<td>3 (13.0)</td>
</tr>
<tr>
<td>Unemployed, n (%)</td>
<td>0 (0.0)</td>
<td>1 (4.3)</td>
</tr>
<tr>
<td>Disabled, n (%)</td>
<td>5 (20.0)</td>
<td>1 (4.3)</td>
</tr>
<tr>
<td>Retired, n (%)</td>
<td>4 (16.0)</td>
<td>10 (43.5)</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last year of study, mean ± s.d.</td>
<td>22.4 ± 16.9</td>
<td>20.2 ± 7.3</td>
</tr>
<tr>
<td>University training, n (%)</td>
<td>8 (32.0)</td>
<td>7 (30.4)</td>
</tr>
<tr>
<td>RA global functional ACR Indexa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACR I, n (%)</td>
<td>7 (28.0)</td>
<td>11 (47.8)</td>
</tr>
<tr>
<td>ACR II, n (%)</td>
<td>16 (64.0)</td>
<td>12 (52.2)</td>
</tr>
<tr>
<td>DAS 28 (1.4–9.3)b, mean ± s.d.</td>
<td>4.9 ± 1.4</td>
<td>4.0 ± 1.7</td>
</tr>
<tr>
<td>VAS (0–100), mean ± s.d.</td>
<td>34.4 ± 23.0</td>
<td>31.4 ± 24.3</td>
</tr>
<tr>
<td>Functional status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAQ (0–3), mean ± s.d.</td>
<td>0.9 ± 0.6</td>
<td>0.7 ± 0.5</td>
</tr>
<tr>
<td>Quality of life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SODA (0–108), mean ± s.d.</td>
<td>60.4 ± 12.6</td>
<td>63.6 ± 6.9</td>
</tr>
<tr>
<td>Dexterity and aerobic fitness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHI (0–90), mean ± s.d.</td>
<td>28.8 ± 21.8</td>
<td>16.0 ± 12.2</td>
</tr>
<tr>
<td>Home bicycle, mean ± s.d.</td>
<td>2.1 ± 2.6</td>
<td>19.6 ± 4.9</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biorelaxation (anti-TNF or IL-1β), n (%)</td>
<td>14 (56.0)</td>
<td>11 (48.0)</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>6 (10–15)</td>
<td>5 (0–10)</td>
</tr>
<tr>
<td>SENS (0–86), median (IQR)c</td>
<td>±3 (9–13)</td>
<td>±5 (2–20)</td>
</tr>
</tbody>
</table>

Notes: aTwo missing values. bTwenty missing values. cAll patients were currently treated with a DMARD. dEight missing values.

Table 2. Content of the DEP: role of occupational therapists and physiotherapists

<table>
<thead>
<tr>
<th>Occupational therapy/Physiotherapy</th>
<th>First week</th>
<th>Second week</th>
<th>Third week</th>
<th>Fourth week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation of the multidisciplinary team</td>
<td>Patient’s individual expectations</td>
<td>Dexterity exercises without resistance</td>
<td>Splint construction and evaluation</td>
<td>Evaluation of disease-related difficulties during usual office tasks</td>
</tr>
<tr>
<td>Evaluation of the patient’s knowledge of the disease and physical capacity in order to design specific programme</td>
<td>Improvement in range of motion</td>
<td>Splint construction</td>
<td>Splint construction</td>
<td></td>
</tr>
<tr>
<td>Explanation of the disease and its consequences</td>
<td>Occupational therapy advice</td>
<td>Increasing resistance and range of motion in dexterity exercises</td>
<td>Residual pain after injury</td>
<td></td>
</tr>
<tr>
<td>Educational booklet</td>
<td>Exercise concerning usual tasks</td>
<td>Strengthening and stretching</td>
<td>Splint construction</td>
<td></td>
</tr>
<tr>
<td>Hydrotherapy</td>
<td>Pain relief</td>
<td>Pain relief</td>
<td>Pain relief</td>
<td></td>
</tr>
<tr>
<td>Improvement in range of motion</td>
<td>Muscles strengthening</td>
<td>Muscles strengthening</td>
<td>Muscles strengthening</td>
<td></td>
</tr>
<tr>
<td>Fitness programme</td>
<td>Comfort in physical activities</td>
<td>Comfort in physical activities</td>
<td>Comfort in physical activities</td>
<td></td>
</tr>
<tr>
<td>Stretching</td>
<td>Relaxation</td>
<td>Relaxation</td>
<td>Relaxation</td>
<td></td>
</tr>
<tr>
<td>Educational booklet</td>
<td>Educational booklet</td>
<td>Educational booklet</td>
<td>Educational booklet</td>
<td></td>
</tr>
</tbody>
</table>
Secondary outcomes

Secondary outcomes included quality of life, functional, clinical, radiological, therapeutic and biological modifications in both groups. The French version of the Arthritis Impact Score 2—Short Form (AIMS2-SF) [20], is a specific questionnaire to assess quality of life in RA patients. AIMS2-SF was not converted to a score of 0–10, but was expressed on a scale from 0 to 60. Nottingham Health Profile (NHP) is a 38-item generic health-related quality of life measure (range 0–60, higher score for greater health problems) [21]. Patient dexterity was evaluated by occupational therapists using Sequential Occupational Dexterity Assessment (SODA) [22] or self-reported by patients using Duruoz Hand Index (DHI) [23]. SODA consists of 12 standardized tasks evaluated by occupational therapists and ranges from 0 (inability to perform tasks) to 108 (no difficulty in performing tasks). The purpose of DHI (range 0—excellent dexterity to 90—poor dexterity) was to measure hand ability while performing personal hygiene, office tasks and other general activities. Simple Erosions Narrowing Score (SENS: range 0–86; [24]) evaluates erosions in 32 joints in the hands, 12 in the feet and joint space narrowing in 30 and 12 joints, respectively. The total SENS score was assessed by a single radiologist unaware of the group assignment. Disease activity was determined using disease activity score (DAS 28: range 0.14–9.3; [25]). A 28-joint count for swelling and tenderness was assessed by a rheumatologist unaware of the treatment allocation. Patients rated their general health on a 100-mm visual analogue scale (VAS). DAS 28 was calculated using the three previously mentioned parameters and ESR. Aerobic fitness was measured on an exercise bike as the distance covered in 5 min [26]. Since the primary outcome (HAQ score) and some of the secondary outcomes (DHI and SODA) are dependant on the upper limb function, we wanted to avoid a difference in dexterity between DEP and control groups. Therefore, Roeder Manipulative Aptitude Test [27], five-handle position grip test [28], Grip and Pinch Strength test [29] were measured at baseline to avoid a potential confounder. The uses of oral and IA drugs as well as other medical devices were noted.

Assessment of outcomes

Primary and secondary outcomes were evaluated at baseline, 1, 6 and 12 months, except for SENS which was evaluated at the baseline and 12 months. Questionnaires were sent by mail to each patient every 3 months. Every clinical evaluation was performed by a physician unaware of the patients’ group allocation.

Statistical analysis

Measures with a Gaussian distribution were expressed as mean ± S.D. and measures with a non-Gaussian distribution were expressed as the median and interquartile range (IQR; expressed as the net result of 75th percentile – 25th percentile). We confirmed with a Kolmogorov–Smirnov test that primary and secondary outcomes, except SENS, were normally distributed.

Statistical significance of the variation of these values from baseline between DEP and standard joint rehabilitation was determined using analysis of covariance (ANCOVA) [30]. P-values <0.05 were considered statistically significant. The analyses were based on the intent to treat as initially assigned. All available data were used. Statistical analysis was performed using Stata 9.0 (Stata Corporation College Station, TX, USA).

Results

Baseline characteristics

Out of 827 patients eligible after screening, 440 were excluded because of exclusion criteria, 312 eligible participants refused the programme and 25 stopped the trial before the baseline visit because of personal reasons not included in the exclusion criteria or unwillingness to participate (infection, travel, etc.). Twenty-five patients were randomly assigned to DEP and 25 to standard joint rehabilitation. Two individuals refused to participate immediately after randomization (Fig. 1). The randomization procedure created two groups whose baseline demographic and disease-related parameters (clinical, functional, radiological and biological) were similar (Table 1) except for RA Global Functional ACR Index which was better in the standard joint rehabilitation group (28% ACR 1 in DEP vs 47.8% in control). Functional status, measured by HAQ, did not differ significantly between the two groups. Thirteen patients in the DEP group and 11 in the standard joint rehabilitation group were treated by either anti-IL-1β or anti-TNF-α; five patients were taking glucocorticoids in the DEP group and nine in the standard joint rehabilitation group. No patients were lost to follow-up, but one subject was not assessed.

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**Fig. 1. Trial flowchart.**

**Assessed for eligibility**

- Excluded n = 777
  - Refused to participate n = 312
  - Did not meet inclusion criteria n = 440
  - Stopped the trial before the baseline visit (infection, travel, etc.) n = 25

**Randomization**

- n = 50

**Allocated to conventional management**

- n = 25
  - Withdrawal before baseline assessment n = 2

**Allocated to DEP**

- n = 25
  - Analysed n = 25

**Analysed n = 23**
for NHP and AIMS2-SF at 1 month. Three patients were not assessed at 6 months and four patients were not assessed at 12 months (Tables 3 and 4).

**Primary end point**

We observed an improvement in HAQ measurement throughout the length of the trial in DEP. This improvement was greater in DEP than in the standard joint rehabilitation group at 1 month (−22% vs no variation from baseline, \( P = 0.04 \)). The variation in HAQ scores from baseline between the two groups did not reach statistical significance at 6 months (−22 vs −14%, \( P = 0.25 \)) or 12 months (−11% vs no variation from baseline, \( P = 0.51 \)) (Table 3). The change in HAQ score in the DEP group at 1 month and 6 months (−0.2) almost reached clinical significance [31].

**Secondary end points**

In the DEP, all parameters globally improved during the trial. This change was most obvious after the first month compared with baseline (DAS 28: 3.8 vs 4.9; NHP: 170.2 vs 220.7; AIMS2-SF: 18.0 vs 21.2; DHI: 19.9 vs 28.8; SODA: 60.6 vs 60.0; and aerobic fitness: 1.4 vs 1.1 km, respectively). A variation of 0.6 points in DAS 28 assessment is commonly considered to be clinically meaningful [31]. NHP and AIMS2-SF scores are presented as a profile rather than overall score and the minimal detectable change or the minimal important change still needs to be assessed. Among the secondary end points, we demonstrated an increase in quality of life measured by NHP in DEP (−23% vs +7% in control, \( P = 0.01 \)) but not AIMS2-SF (−15% vs +2% in controls, \( P = 0.09 \)) at 1 month (Table 4). Improvement of aerobic fitness, measured on an exercise bike, was statistically better in the DEP group than in the standard joint rehabilitation group (+0.2 km in 5 min, \( P = 0.02 \)), but no statistically functional superiority of DEP could be detected on DHI (\( P = 0.35 \)) or SODA (\( P = 0.30 \)) at 1 month (Table 4).

Although quality of life and disease activity demonstrated a positive trend at 6 and 12 months in comparison with baseline (Tables 3 and 4), the changes of DAS 28, NHP, AIMS2-SF, DHI and SODA were not statistically significant between groups. Although not statistically different from the control group, improvement in DHI at 1 month (from 28.8 to 19.9), 6 months (from 28.8 to 15.4) and 12 months (from 28.8 to 19.2) is higher than the minimal detectable change [32]. Aerobic fitness, measured on an exercise bike, improved with DEP but not with standard joint rehabilitation at 6 months (+18% vs no variation, \( P = 0.20 \)) and at 12 months (+18 vs −8%, \( P = 0.16 \)). The radiological evaluation did not demonstrate any difference between the two groups at 12 months. We did not observe any significant worsening in SENS assessment in DEP in comparison with control.

**Safety and compliance**

No adverse effects were seen in either group. Two patients in the DEP and four patients in the standard joint rehabilitation group switched to another anti-TNF-α treatment. There was no difference in disease activity or inflammatory parameters (DAS 28, VAS, ESR and CRP) between the groups during the trial. There were no dropouts from either group.

**Discussion**

Previous studies supported evidence for improvement of aerobic fitness [9–11, 16, 33] and muscle strength [11, 33–37] after exercise interventions in RA. The specific effects of exercise on functional status evaluated by HAQ or quality of life remain unclear [38]. This randomized controlled single-blind study achieved its primary end point, i.e. the reduction of HAQ and demonstrated that a DEP provided better effects on quality of life (NHP) than conventional joint rehabilitation at 1 month.

Although our results are promising, some limitations must be considered. First, we did not record either patients’ current level of physical activity or their recent experience with rehabilitation, which could influence the baseline test parameters and the subsequent change at the different end points. Patients’ allocation was randomly performed but we cannot be sure that these potential confounders were equally distributed in DEP and control groups. Secondly, we evaluated compliance as the number of completers but not as the percentage of the maximum possibly attended sessions. Among previous studies reporting compliance as the number of completers, a discrepancy in compliance was unlikely to explain the good result in the DEP group. Most previous studies reported compliance as the number of completers but not as the percentage of the maximum possibly attended sessions, which appears to be a more precise measurement of compliance. There was excellent compliance in our study with no withdrawals from either group. This result is in concordance with previous studies describing at least 70% completion in the intervention groups. As both groups in our study underwent different types of interventions (intensive aerobic exercise vs education and classical rehabilitation), a discrepancy in compliance is unlikely to explain the good result in the DEP group. Most previous studies reported compliance as the number of completers but not as the percentage of the maximum possibly attended sessions. Among the 32 RCTs comparing an aerobic exercise programme to less

**Table 3. Primary outcome (HAQ) during follow-up**

<table>
<thead>
<tr>
<th></th>
<th>DEP (N = 25)</th>
<th>Control (N = 23)</th>
<th>Change from baseline (%)</th>
<th>Mean (S.D.)</th>
<th>Mean (S.D.)</th>
<th>( P )-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAQ 1 month</td>
<td>0.7 (0.6)</td>
<td>0.7 (0.6)</td>
<td>−22</td>
<td>0.0 (0.2)</td>
<td>0.0 (0.2)</td>
<td>0.04</td>
</tr>
<tr>
<td>HAQ 6 months( a )</td>
<td>0.7 (0.6)</td>
<td>0.6 (0.6)</td>
<td>−22</td>
<td>0.0 (0.2)</td>
<td>0.0 (0.2)</td>
<td>0.25</td>
</tr>
<tr>
<td>HAQ 12 months( a )</td>
<td>0.8 (0.6)</td>
<td>0.7 (0.5)</td>
<td>−11</td>
<td>0.0 (0.3)</td>
<td>0.0 (0.3)</td>
<td>0.51</td>
</tr>
</tbody>
</table>

\( *P \)-values are determined using ANCOVA.

**Table 4. Secondary outcomes (disease activity, disability, quality of life status, dexterity and aerobic fitness) during follow-up**

<table>
<thead>
<tr>
<th></th>
<th>DEP (N = 25)</th>
<th>Control (N = 23)</th>
<th>Change from baseline (%)</th>
<th>Mean (S.D.)</th>
<th>Mean (S.D.)</th>
<th>( P )-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAS 28</td>
<td>3.8 (2.1)</td>
<td>4.0 (1.6)</td>
<td>−22</td>
<td>0.0 (0.2)</td>
<td>0.0 (0.2)</td>
<td>0.19</td>
</tr>
<tr>
<td>NHP</td>
<td>170.2 (129.4)</td>
<td>215.7 (140.9)</td>
<td>−31</td>
<td>18.1 (7.1)</td>
<td>18.1 (7.1)</td>
<td>0.01</td>
</tr>
<tr>
<td>DHI</td>
<td>19.9 (16.9)</td>
<td>14.6 (15.9)</td>
<td>−31</td>
<td>1.2 (0.2)</td>
<td>1.2 (0.2)</td>
<td>0.09</td>
</tr>
<tr>
<td>SODA</td>
<td>60.6 (11.4)</td>
<td>60.8 (11.1)</td>
<td>0</td>
<td>0.0 (0.3)</td>
<td>0.0 (0.3)</td>
<td>0.35</td>
</tr>
</tbody>
</table>

**Change from baseline (%)**

| Exercise bike (km/5 min) | 1.4 (0.3) | 1.3 (0.2) | 0.0 (0.3) |

\( *P \)-values are determined using ANCOVA.

\( a \) denotes no disability to 3—great disability.

\( *a \) Three patients not assessed.

\( *b \) Four patients not assessed.

\( *P \)-values are determined using ANCOVA.

\( a \) denotes no disability to 3—great disability.

\( *a \) Three patients not assessed.

\( *b \) Four patients not assessed.

\( *P \)-values are determined using ANCOVA.
intensive rehabilitation in RA, only six trials (19%), whose intervention lasted at least 12 weeks, evaluated this parameter. In a home-based physical activity intervention, Van den Berg et al. [39] reported that 34% of patients were physically active in the intervention group. Thirdly, the small number of patients included in this study is likely to be insufficient to detect a statistical difference in the primary and secondary outcomes between both groups at 6 and 12 months. Finally, missing data could yield biased results in our intent to treat statistical analysis. Contrary to the numerous missing values in baseline home-bicycle sprint assessment that might limit the conclusion of a DEP effect on physical capacity, only seven HAQ measurements (4%) were missing, which is unlikely to constitute an attrition bias.

Our findings confirm the results of earlier studies [36, 40], which reported a lower HAQ in an exercise intervention group, contrasting with most of the previous studies that failed to detect any statistical difference in HAQ variation between interventional and conventional joint rehabilitation [11, 14, 41, 42]. Two trials [8, 15] were able to show that DEP provides better functional results than control. In these studies—the McMaster Toronto Arthritis Patient Preference Questionnaire (MAPCTAR) and SF-36—two quality of life questionnaires containing functional ability items were used to assess functional impairment. To assess this last parameter we selected the widely used HAQ questionnaire that appears to be more specific for the functional ability assessment in RA. This index more depends on disease activity and pain than limb function and is more sensitive to detect change in function of the upper limbs than the lower limbs [43]. It is probably more appropriate in pharmacological trials than in physical intervention trials and might therefore be less sensitive to changes in groups with a score below 1.00 [44]. Thus, by using HAQ we possibly missed small but clinically relevant improvement of lower limb disability, and the lack of significant improvement of HAQ after 1 month may reflect an inability of this index to detect the effects of DEP rather than a failure of DEP to improve patients’ functional status [38, 43]. Similarly, as Stenström et al. [45] reported an improvement of NHP score after dynamic training in patients with inflammatory rheumatic diseases, we have shown that the intervention group displayed improved health-related quality of life with NHP being statistically higher in DEP than in the control group as early as the first month. After the first month, the exercises were home-based and self-administered. The patients could therefore no longer benefit from the group dynamic, explaining the reduction in effect of DEP on NHP and other questionnaires concerning quality of life with time. Therefore, we cannot exclude that the enthusiasm of patients and the health professionals involved in this short-term intervention trial influenced the outcome.

The cost effectiveness of DEPs compared with usual management could not be evaluated because of missing data on self-reported questionnaires. We were unable to quantify the impact of a DEP on work and on the consumption of medical and para-medical resources, in order to determine whether the intervention programme, which is more expensive (10 000 euros for a DEP vs 1500 euros for usual management), was economically relevant.

The radiological evaluation did not demonstrate any deleterious effects of the DEP, which is consistent with two previous studies [8, 14]. Although our study was underpowered to prove any benefit in the DEP group in terms of joint damage, a previous study has reported less erosive change in patients treated with a DEP compared with usual care physical therapy [46]. Given that both study groups displayed differences of disease duration and baseline joint damage, no solid conclusions could be drawn on the protective effect of exercise on joints from this study [7]. Molecular mechanisms are still unclear but some cytokines such as insulin growth factor I (IGF1) are up-regulated in DEP [47].

Our study, based on stringent methodological procedure, provides evidence for quality of life improvement following DEP. We have confirmed that this type of intervention has positive consequences on aerobic fitness with excellent compliance.

**Rheumatology key messages**

- A DEP in RA improves HAQ at 1 month but not subsequently.
- DEP provides beneficial effects on quality of life.

**Acknowledgement**

We thank Aurélie Petitprin for her help in writing this article.

**Disclosure statement**: The authors have declared no conflicts of interest.

**References**

A dynamic exercise programme for RA patients