Exercise therapy and orthotic devices in rheumatoid arthritis: evidence-based review

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Key points

(1) Rheumatoid arthritis is a chronic, systemic inflammatory disease of the peripheral joints that causes painful disability and reduces patients' physical function, with a substantial negative impact on health-related quality of life (HRQL).

(2) Exercise therapy, including aerobic or strengthening exercises, and orthotic devices are utilised in conjunction with pharmacological therapies to improve the symptoms of pain and fatigue and improve HRQL in rheumatoid arthritis patients.

(3) Randomised, controlled trials demonstrate the beneficial effects of regular aerobic exercise and/or strengthening exercises on physical function and symptoms of pain and fatigue in rheumatoid arthritis patients. However, exercise therapy does not appear to improve disease activity.

(4) Pain and physical function were significantly improved with standard or customised foot orthoses in small, controlled or crossover studies, and with wrist splints in two randomised, controlled trials in rheumatoid arthritis patients.

(5) More data from large, well-controlled studies are required to fully elucidate the role of exercise therapy and orthotic devices in the management of rheumatoid arthritis. In particular, studies evaluating the use of these therapies on disease activity would be useful.

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Background

Rheumatoid arthritis (RA) is a chronic, systemic disease characterised by inflammation and gradual destruction of the peripheral joints [1,2]. It affects up to 1% of the population worldwide and occurs in almost twice as many women as men [2]. While the precise aetiology of the disease is unknown, its clinical course is well understood; joint destruction begins within a few weeks of the onset of symptoms of pain, joint stiffness and/or fatigue.

Involvement of the hands and feet is common. Inflammation of the wrist joint occurs in approximately 75% of RA patients and reduced grip strength and dexterity is frequent [3]. Up to 92% of RA patients experience painful, disabling foot deformities such as hallux valgus, splaying of the forefoot, flattened longitudinal arches and valgus hindfoot [4,5]. RA patients characteristically display a slow shuffling gait with short strides that lacks the usual heel-toe pattern. These local effects, in conjunction with the general impact of the disease, cause progressive functional impairment that can prevent patients from participating in work, leisure and normal daily living activities [2]; up to 30% of patients cannot work within 3 years of diagnosis because of RA-associated disability [6]. Consequently, RA is associated with a substantial negative burden on health-related quality of life (HRQL) [1,7].

The management of RA targets both the physical and social/psychological aspects of disease. The primary aims of management are to prevent or control joint damage, minimise pain, maintain physical function and improve HRQL through social and psychological support [1,7]. Non-pharmacological modalities such as exercise therapy or orthotic devices are commonly used in conjunction with pharmacological therapy to maintain symptom control and HRQL in RA patients.

Treatment guidelines published by the British Society for Rheumatology (BSR) & British Health Professionals in Rheumatology (BHPR) [7], American College of Rheumatology (ACR) [1] and Ottawa Panel [8] recommend the use of exercise therapy in RA patients for improvement of joint mobility, muscle strength and overall physical function without detrimental effects on joint symptoms or fatigue, as well as for maintaining overall patient HRQL [1,7,8]. The BSR & BHPR guidelines differentiate between types of exercise: range of motion (ROM) exercises are advocated for improving joint mobility; resistance-based exercises may improve muscle strength; and aerobic exercise is recommended to improve physical function and general fitness [7]. Hydrotherapy, in which exercise is conducted in a temperate pool, may be beneficial in terms of pain, function and HRQL [7]. These treatment recommendations are supported by a

Cochrane Review conducted in 2000, which found that dynamic exercise therapy effectively increased aerobic capacity and muscle strength in patients with RA, with no detrimental effects on disease activity or pain [9]. To date, however, there have been few clinical studies evaluating the effects of exercise therapy on disease progression, and it is unclear whether dynamic exercise has any impact on functional ability or radiological progression of RA.

Similarly, despite extremely limited data on the efficacy of orthotic devices, it is standard practice to prescribe foot orthoses or specialised footwear in RA patients with the aims of stabilising joints, improving foot positioning and function and reducing pain, stiffness and swelling [7]. Wrist splints may be used to improve patients' abilities to grasp and manipulate objects [3]; a recent Cochrane review reported that provision of splints effectively improves pain in RA patients [10].

Review of the evidence

This review examines current evidence for the efficacy of exercise therapy and orthotic interventions in the treatment of RA. For exercise therapy studies, we evaluated the effect of treatment on clinical outcomes such as disease progression, where available, or subjective assessments of HRQL and functional impairment. For studies of orthotic devices, we focused on those evaluating the impact of device use on subjective assessments of pain, HRQL and functional impairment and, for studies in patients with foot deformity, assessments of device use on gait.

Search strategy

English language articles published in the last 10 years were searched in November 2007 using Medline (1997 to date), Embase (1997 to date), the Cochrane Library (1997 to date) and Odyssey (a proprietary database of Wolters Kluwer Health). Search terms were: 'arthritis, rheumatoid' AND ('orthotic devices OR 'exercise therapy' OR 'hydrotherapy'). Additional studies fitting the search criteria were obtained by searching the reference lists of key papers.

Inclusion/exclusion criteria

For studies of exercise therapy, only fully-published, randomised, controlled trials (RCTs) conducted in RA patients were included. Studies using healthy volunteers as controls were excluded. Studies of aerobic exercise interventions were included if the exercise programmes incorporated exercise of at least moderate intensity (60–80% of maximum heart rate) during at least 20 min, performed at least twice per week for at least 6 weeks. Systematic reviews and meta-analyses of fully-published RCTs meeting these criteria were included where available. RCTs with a mixed population of patients with RA and osteoarthritis were included if results were reported separately for each patient group. For studies of orthotic devices, we included randomised studies in at least 15 patients in which a control device or a crossover design was employed.

Data extraction and synthesis

Data on the effects of the use of physical therapy or orthotic devices on clinical outcomes in patients with rheumatoid arthritis were extracted. The results obtained are presented narratively.

Results

Exercise therapy

Six RCTs of land-based exercise therapy (Table 1) [11–16] and 2 RCTs of hydrotherapy (Table 2) [17,18] met our inclusion criteria. Data from a systematic review of RCTs of the effects of aerobic exercise on patients with RA were included [19], along with data from a Cochrane review of dynamic exercise therapy in RA patients [9]. Additionally, *post-hoc* analyses [20–22] of the Rheumatoid Arthritis Patients in Training (RAPIT) study [11] that reported the effects of exercise on disease activity and progression were included.

Among the studies of land-based exercise therapy, there were two trials of aerobic exercise only [12,16], one of non-aerobic exercise only [13], and three studies of combination aerobic plus non-aerobic exercise programmes [11,14,15]. Disease activity outcomes were evaluated as a primary or co-primary endpoint in three studies [12,14,15]. The study by Van den Ende and colleagues [14] calculated the Disease Activity Score with four variables (DAS4), including the Ritchie Articular Index, 44 swollen joint count, erythrocyte sedimentation rate (ESR), and a visual analogue scale (VAS); the DAS4 was also assessed as a secondary endpoint in the RAPIT trial [11]. The other studies evaluating disease activity as a primary endpoint evaluated total joint count, ESR and C-reactive protein levels [12] or swelling, tenderness or pain with pressure in 70 peripheral joints [15].

The remaining studies assessed patient-reported physical function and/or HRQL outcomes as primary endpoints [11–13,16,18]. Assessment tools include the Rheumatoid Arthritis Quality of Life (RAQoL) questionnaire, the McMaster Toronto Arthritis (MACTAR) Patient Preference Disability Questionnaire and the Health Assessment Questionnaire (HAQ) in the RAPIT study [11], the 'Quality of life questionnaire for patients with rheumatoid arthritis' [16], the Arthritis Impact Measurements Scales (AIMS) II subscale [13] and the modified Functional Capacity Evaluation [18]. The study by Neuberger and colleagues assessed the overall symptom score for fatigue, pain and depression based on data from the 14-item Global

Table 1 Randomised, controlled studies of exercise therapy in patients with RA

Study	Intervention [intensity; duration; frequency] (n)	Control (n)	Length	Primary endpoint(s)	Main results
Aerobic exercise only					
Neuberger *et al.* [12]	Class exercise [60–80% MHR; 1 h; 3×/wk] (68), or Videotape-based home exercise [60–80% MHR; 1h; 3×/wk] (79)	Usual physical activity (73)	12wk	Overall symptom scores for fatigue, pain and depression;[b] disease activity;[c] and physical function (grip strength and walk time)[d]	Overall symptoms decreased significantly from BL at wk 12 in the class exercise group vs controls ($p < 0.04$); there was no significant between-group difference with home exercise vs control Disease activity was unchanged from BL at wk 12 in all pts Walk time and grip strength were significantly improved from BL in both exercise groups vs controls ($p \leq 0.005$)
Yang *et al.* [16]	Treadmill [60–80% MHR; 30 min; 4×/wk] (n = 85)	Usual physical activity (41)	12wk	HRQL questionnaire scores	The aerobic exercise group achieved significantly higher scores than the control group on HRQL questionnaire: physical (3.5 vs 2.0), emotional/ psychological (2.0 vs 1.4), social function (3.0 vs 1.6), self-recognised health status (2.0 vs 0.0) and total (3.4 vs 2.0) scores [all $p < 0.05$]
Non-aerobic exercise only					
O'Brien *et al.* [13]	Group 1: Joint protection leaflet plus hand-strengthening and mobilizing exercises [5–20 repetitions twice daily] (21) Group 2: Joint protection leaflet plus hand-mobilizing exercises [5–20 repetitions twice daily] (24)	Joint protection le aflet alone (22)	6mo	AIMS II upper limb, and hand and finger subscale scores	Change from BL in AIMS II score at 6 months was significantly better in group 1 vs groups 2 and control (−1.07 vs +0.18 and +0.30; $p = 0.007$)
Aerobic plus non-aerobic exercise					
RAPIT [11][a]	RAPIT programme: Home bicycle [70–90% MHR; 20 min; 2×/wk] plus exercise circuit [muscle strength and endurance, joint mobility and ADL exercises; 20 min; 2×/wk] plus sport or game [impact sport; 20min; 2×/wk] (150)	Usual physical therapy as prescribed by physician (150)	2y	Functional ability according to MACTAR Patient Preference Disability Questionnaire and the HAQ	RAPIT group was superior to usual care group for mean difference in change from BL in MACTAR score after 1 year (2.6; 95% CI 0.1, 5.2) and 2 years (3.1 [95% CI 0.7, 5.5) and change in HAQ after 2 years (−0.09; 95% CI −0.178, −0.01)
Van den Ende *et al.* [14]	Intensive exercise: dynamic and isometric knee and shoulder strenthening exercises [70% MVC; 5×/wk] plus home bicycle [60% MHR; 15 min; 3×/wk] (34)	Usual care: ROM and isometric exercises [4×/wk] (30)	24w	Number of swollen joints during first 3wk	No statistically significant between-group differences with intensive exercise vs usual care in the number of swollen joints at wk 3 (1 vs 0), 6 (−1 vs −1), 12 (−2 vs −1) or 24 (−6 vs −3)
Westby *et al.* [15]	Aerobic dance [60–75% MHR; 15–20 min; 3×/wk] plus muscle strenthening exercises [10–15 min; 3×/wk] (14)	Usual care (16)	1y	Disease activity (swelling, tenderness or pain with over-pressure in 70 peripheral joints)	No significant between-group differences in the decrease from BL in disease activity at 1y (from 17.5 to 16.2 with exercise and from 30.4 to 31.0 with usual care)

ADL, activities of daily living; AIMS II, Arthritis Impact Measurement Scales II; BL, baseline; CI, confidence interval; HAQ, Health Assessment Questionnaire; HRQL, Health-related Quality of Life; MACTAR, McMaster Toronto Arthritis; MHR, maximum heart rate; MVC, maximum voluntary contraction; RAPIT, Rheumatoid Arthritis Patients In Training; ROM, range of motion.

[a] Groups were not comparable at baseline.

[b] Fatigue was assessed using the 14-item Global Fatigue Index of the Multidimensional Assessment of Fatigue questionnaire; pain was assessed using the Short Form McGill Pain Questionnaire; depression was assessed using the Center for Epidemiological Studies Depression Scale. Structural equation modelling was employed to determine the overall treatment effect.

[c] Disease activity was determined via total joint count, erythrocyte sedimentation rate and C-reactive protein level.

[d] Function assessments including grip strength and walk time assessed by a physical therapist.

[e] Primary endpoint not reported.

Table 2 Randomised, controlled studies of hydrotherapy in RA patients

Study	Intervention [intensity; duration; frequency] (n)	Control (n)	Duration	Primary endpoint(s)	Main results
Bilberg *et al.* [17]	Aquatic aerobic exercise [moderate intensity; 45 min; 2×/wk] (20)	Land-based home exercise program as instructed by physician (23)	12wk	Aerobic capacity on submaximum ergometer cycle and the physical component of the SF-36	No significant between-group differences in changes from BL in aerobic capacity or SF-36 physical component scores
Suomi *et al.* [18]	Aquatic exercise as per the AFAP protocol [45 min; 2×/wk] (10) or land-based exercise as per the PACE protocol [45 min; 2×/wk] (10)	Usual activity (10)	8wk	Functional fitness, ADL (according to Functional Capacity Evaluation) and hand-held dynamometry measures	Significant improvements from BL with aquatic and land-based exercise in 9 of 12 functional fitness, 3 of 4 ADL and 7 of 8 hand-held isometric strength tests; no significant improvements in control group

ADL, activities of daily living; AFAP, Arthritis Foundation Aquatic Programme; BL, baseline; PACE, People with Arthritis Can Exercise; ROM, range of motion; SF-36, Short Form HRQL questionnaire.

Fatigue Index of the Multidimensional Assessment of Fatigue questionnaire, the Short Form of the McGill Pain Questionnaire, and the Centre for Epidemiological Studies Depression Scale [12].

Land-based Exercise

Disease Activity

At worst, aerobic exercise appears to have no effect on disease activity in RA patients [9,12,15]. There were no statistically significant improvements or worsening in the number of involved joints after either short-term (12 or 24 weeks) [9,12] or long-term (1-year) exercise programmes [15] (Table 1).

Post-hoc analyses of data from the RAPIT trial suggest that any potential improvements in disease activity with exercise are limited to those patients with little or no joint damage at baseline. One analysis found that after 2 years, patients undertaking regular exercise had significantly less radiological damage to joints of the hands and feet (Larsen score for mean increase from baseline in joint damage 3.5 with exercise vs 5.7 with control; $p = 0.045$) [21]. However, the proportions of patients experiencing joint damage progression over 2 years were significantly higher among patients in the exercise group with extensive damage to large joints (Larsen score > 5) at baseline (45% vs 85%; $p < 0.05$) [22]. In contrast, similar proportions of patients in the exercise and control groups with little or no joint damage at baseline (Larsen score ≤ 5) experienced increases in joint damage (35% vs 36%) [22].

Overall, the small number of studies assessing disease activity as a primary outcome means that conclusions regarding the effect of exercise therapy on disease progression in RA must be made with caution. Consistent with the conclusions of the Cochrane review [9], further studies are required to establish the effect of exercise therapy on long-term radiological progression of RA.

Functional Ability and HRQL

Functional ability and HRQL were generally improved with exercise (Table 1). Compared with controls, there were significantly greater improvements from baseline in symptoms, walk time and grip strength among patients completing a 12-week aerobic exercise programme in the study by Neuberger and colleagues [12]. Similarly, in the RAPIT study, significantly greater improvements in functional ability were observed in patients undertaking high-intensity, weight-bearing exercise versus controls; these benefits were maintained for up to 2 years [11]. The study evaluating non-aerobic hand strengthening and mobilizing exercises reported significant improvements in hand and finger function after exercise (Table 1) [13].

The results of these trials are consistent with the conclusions of the Cochrane review, which found that dynamic exercise therapy was both safe and effective for improving physical function in RA patients [9]. In contrast, the systematic review found that the effect of exercise on pain, physical function and HRQL in RA patients was unclear, based on a lack of effect observed in many studies [19]. Nonetheless, the authors of this review concluded that aerobic exercise of at least moderate intensity conducted at least three times weekly for 30–60 min was recommended in RA patients, along with moderate to hard strengthening exercises 2–3 times per week [19]. Thus, the overall weight of current evidence suggests that interventions comprising regular aerobic exercise of at least moderate intensity and/or non-aerobic strengthening exercises have a beneficial effect on functional ability and symptoms of fatigue and depression in RA patients.

Hydrotherapy

Hydrotherapy appears to produce improvements in HRQL and functional capacity that are not significantly different from those of land-based exercise (Table 2). The study by Bilberg and colleagues found no significant between-group differences with hydrotherapy versus land-based exercise in HRQL measures [17]. In this study, the hydrotherapy group experienced significant improvements from baseline in SF-36 (Short Form 36 HRQL questionnaire) scores for physical functioning (+9.5; $p < 0.001$), bodily pain (+10.7; $p < 0.01$), vitality (+12.1; $p < 0.01$), and physical component dimensions (+4.8; $p < 0.01$) and in AIMS II physical (−0.6; $p < 0.01$) and HAQ score (−0.2; $p < 0.05$) [17]. Similarly, in the study by Suomi and colleagues, both hydrotherapy and land-based exercise produced similar improvements from baseline in functional capacity and strength in older RA patients (aged 60–79 years) [18]. Although these studies were of insufficient size to demonstrate equivalent efficacy between hydrotherapy and land-based exercise, and were not specifically designed to demonstrate equivalence between the two regimes, the results suggest that there are no major differences in efficacy with hydrotherapy or land-based exercise.

Orthotic devices

Foot orthoses

Four randomised studies evaluating the effects of foot orthoses on pain and functionality in RA patients were identified, including three parallel-group trials that utilised control orthotic devices (traditional or usual-care orthoses) [23,24,26] and one crossover study [25] (Table 3). One of the parallel-group studies [26] incorporated a 2-phase design, in which the initial 2-month randomised, controlled, parallel-group trial was followed by a non-randomised, repeated-measures analysis during which control subjects were supplied with orthotic footwear and re-assessed after 2 months. Efficacy outcomes were pain, assessed using VAS scores, and functionality, which was assessed via patient-reported HRQL assessment tools [23–26]. These included the Foot Function Index (FFI), a validated questionnaire incorporating a VAS in which patients rate 23 items in three domains (foot pain, disability and functional limitation), the Foot Health Status Questionnaire (FHSA), a validated questionnaire comprising two sections (one with four domains [foot pain, foot function, footwear and general foot health] and one incorporating SF-36 questions on social capacity, general health and vigour), and the Stanford Health Assessment Questionnaire (HAQ), which consists of 20 questions in 8 categories on various tasks of daily living rated on a 4-point scale (0 = without any difficulty; 3 = unable to do) [23–26].

Additionally, the effects of foot orthoses on gait and plantar pressures were assessed in two small randomised trials, including one of the above-mentioned randomised studies (n = 30) [26] and a single-use study of palliative orthoses (n = 16) [27].

Physical function and pain were significantly improved with the use of specialised foot orthoses (Table 3) [23–26]. The non-randomised repeated-measures analysis supported the results of the randomised, controlled phase of this study, demonstrated significant improvements in physical function, walk pain, stair pain, and pain-free walk time [26]. Significantly lower mean VAS scores for pain were also reported by patients using palliative orthoses in the single-use study evaluating gait (18.87 vs 42.06 without orthotics; $p = 0.008$) [27].

The effects of foot orthoses on gait are unclear; although the single-use study reported no improvements on gait with palliative orthoses [27], the randomised study demonstrated improvements with orthotic footwear in mean normal velocity (6.4 cm/s) and stride length (5.5 cm), and in fast velocity (8.6 cm/s) and stride length (5.8 cm) [$p < 0.05$ vs baseline for all comparisons] [26].

Wrist splints

Two randomised, crossover studies evaluating the effects of up to 4 weeks' wrist splint use in RA patients found that splints improved wrist pain and functionality without compromising dexterity (Table 3) [3,28]. The study by Haskett and colleagues reported significant improvements from baseline in pain with only two of the three splint types (Table 3). However, all three splint types (the wrist extensor orthosis, custom leather splint and elastic splint) produced significant improvements versus baseline in strength as measured by grip pressure (144, 148 and 140 vs 121 mm Hg;), two-point pinch weight (2.9, 2.8 and 2.8 vs 2.4 kg) and three-point pinch weight (3.61, 3.58 and 3.61 vs 3.3 kg) [$p \leq 0.02$ vs baseline for all

Table 3 Effects of foot or wrist orthotic device use on pain and functionality in patients with RA

Study	Patient inclusion criteria (n)	Study design; duration	Interventions	Primary endpoint(s)	Main results
Foot Orthoses					
Woodburn *et al.* [24]	Correctable valgus rearfoot deformity (98)	Active control; 30 mo	Custom manufactured rigid foot orthoses with podiatry supervision vs foot orthoses prescribed under usual care	Total FFI score	Significantly greater reduction from BL after 30 mo with custom foot orthoses vs controls in total FFI score (−241.3 vs −22.8; $p=0.026$) and FFI pain (−333.4 vs −25.6; $p=0.014$) and disability (−334.1 vs −25.0; $p=0.016$) subscale scores
Williams *et al.* [23]	Foot deformity and pain (80)	Active control; 12 wk	Newly-designed specialist orthotic shoe vs traditional specialist therapeutic shoe	FFI and FHSQ scores	Significantly better scores at wk 12 with specialist orthotic show than with traditional shoe in FHSQ foot pain (65.04 vs 39.45), foot function (59.72 vs 32.99) and general foot health scores (37.29 vs 19.44) [$p \leq 0.05$ for all comparisons] and in FFI total scores (21.26 vs 37.56; $p=0.01$)
Chalmers *et al.* [25]	Minimum of 2 subluxed MTP joints bilaterally with MTP pain as their most significant foot problem (28)	3-way crossover; 12 wk per period with 2 wk washouts	Supportive shoes vs supportive shoes with soft orthoses (made from plastazote®) vs supportive shoes with semi-rigid orthoses (made from 3 mm subortholen®)	Pain VAS score	Significantly lower pain VAS score at wk 12 with rigid orthoses (2.88) than with soft orthoses (4.27) or shoes alone (4.79) [$p=0.006$]
Fransen & Edmonds [26]	Foot pain for ≥ 1y (30)	Active control; 2 mo[a]	Orthopaedic shoes (Xtra Depth) vs usual low-heel shoes	Lower limb pain VAS score; physical function (Stanford HAQ)	Significant changes from BL with orthoses vs no orthoses in VAS scores for walk pain (−17.2 [$p=0.001$] vs 1.5) and stair pain (−18.4 [$p=0.001$] vs 3.6), and in mean HAQ score (−0.20 [$p=0.04$] vs 0.00)
Wrist Orthoses					
Haskett *et al.* [3]	Wrist swelling, wrist pain on direct pressure or motion, and wrist range of motion restricted by ≥ 20% (45)	3-way crossover; 4 wk per period with 1 wk washout	Rolyan wrist extensor orthosis vs custom-made leather wrist splint vs Anatomical Technologies elastic wrist support	Pain VAS score	Significant reductions in VAS scores from BL (4.1) with the Rolyan wrist extensor orthosis (3.3; $p=0.06$), custom-made leather wrist splint (2.8; $p=0.001$) but not the Anatomical Technologies elastic wrist support (3.8; $p=0.38$)
Pagnotta *et al.* [28]	Pain at rest or on exertion due to synovitis (determined by rheumatologist) or damage of the radiocarpal joint (40)	2-way crossover; 1 wk per period	Commercial working wrist splint (Futuro Kendall #33) vs no splint	Work performance (screwdriver task); Dexterity (Jebsen Hand Function Test); Pain (VAS score on shears and screwdriver tasks)	Significantly better outcomes after 1 wk of wrist splint use than without splint for work performance (431 vs 644 inch-pound-degrees/time; $p=0.0002$), dexterity (62.0 vs 57.6 s; $p=0.0086$) and pain (VAS shear task: 1.78 vs 2.30; $p=0.0120$; VAS screwdriver task: 1.99 vs 2.44; $p=0.0007$)

BL, baseline; FFI, Foot Function Index; FHSQ, Foot Health Status Questionnaire; HAQ, Health Assessment Questionnaire; MTP, metatarsal phalangeal; VAS, visual analogue scale.
[a] This study also incorporated a 2-month repeated-measures analysis following the initial 2-month randomised, controlled trial.

comparisons] without compromising dexterity [3]. There were no significant differences between the splint types in terms of improvements from baseline in pain or functionality, except that the Rolyan wrist extensor orthosis produced significantly stronger grip than the elastic wrist support ($p = 0.04$), and pegboard dexterity was significantly more compromised with the custom leather splint than with the elastic wrist support ($p = 0.03$). Thus, this study did not demonstrate superiority of one type of wrist splint over another [3].

Conclusions

On the basis of the current evidence evaluated in this review, it appears that exercise therapy comprising aerobic exercise and/or strengthening exercises improves functional ability and the symptoms of fatigue and depression in RA patients. This finding supports current British, American and Canadian treatment guideline recommendations that exercise be implemented in conjunction with pharmacological therapy for the management of RA. Similarly, the available evidence suggests that foot orthoses and wrist splints produce substantial improvements in patient-reported pain and physical function and that the long-term use of customised foot orthoses may lead to stability in the ankle joint complex. However, these conclusions must be interpreted cautiously because of the limited number of well designed studies and the small patient populations in many studies. Larger, well-controlled long-term studies are required to fully assess the long-term efficacy of exercise therapy and orthotic devices in the management of RA.

References

1 Guidelines for the management of rheumatoid arthritis: 2002 Update. Arthritis Rheum, 2002; 46:328–346.

2 Rindfleisch JA, Muller D. Diagnosis and management of rheumatoid arthritis. Am Fam Physician 2005; 72:1037–1047.

3 Haskett S, Backman C, Porter B, *et al.* A crossover trial of custom-made and commercially available wrist splints in adults with inflammatory arthritis. Arthritis Rheum 2004; 51:792–799.

4 Balint GP, Korda J, Hangody L, Balint PV. Regional musculoskeletal conditions: foot and ankle disorders. Best Pract Res Clin Rheumatol 2003; 17:87–111.

5 Shi K, Tomita T, Hayashida K, *et al.* Foot deformities in rheumatoid arthritis and relevance of disease severity. J Rheumatol 2000; 27:84–89.

6 Sokka T. Work disability in early rheumatoid arthritis. Clin Exp Rheumatol 2003; 21 (5 Suppl 31):S71–S74.

7 Luqmani R, Hennell S, Estrach C, *et al.* British Society for Rheumatology and British Health Professionals in Rheumatology Guideline for the Management of Rheumatoid Arthritis (The first 2 years). Rheumatology (Oxford), 2006.

8 Ottawa Panel evidence-based clinical practice guidelines for therapeutic exercises in the management of rheumatoid arthritis in adults. Phys Ther, 2004; 84:934–972.

9 Van den Ende CH, Vliet Vlieland TP, Munneke M, Hazes JM. Dynamic exercise therapy for rheumatoid arthritis. Cochrane Database Syst Rev, 2000: CD000322.

10 Steultjens EM, Dekker J, Bouter LM, *et al.* Occupational therapy for rheumatoid arthritis. Cochrane Database Syst Rev, 2004:CD003114.

11 de Jong Z, Munneke M, Zwinderman AH, *et al.* Is a long-term high-intensity exercise program effective and safe in patients with rheumatoid arthritis? Results of a randomized controlled trial. Arthritis Rheum 2003; 48:2415–2424.

12 Neuberger GB, Aaronson LS, Gajewski B, *et al.* Predictors of exercise and effects of exercise on symptoms, function, aerobic fitness, and disease outcomes of rheumatoid arthritis. Arthritis Rheum 2007; 57:943–952.

13 O'Brien AV, Jones P, Mullis R, *et al.* Conservative hand therapy treatments in rheumatoid arthritis–a randomized controlled trial. Rheumatology (Oxford) 2006; 45:577–583.

14 van den Ende CH, Breedveld FC, le Cessie S, *et al.* Effect of intensive exercise on patients with active rheumatoid arthritis: a randomised clinical trial. Ann Rheum Dis 2000; 59:615–621.

15 Westby MD, Wade JP, Rangno KK, Berkowitz J. A randomized controlled trial to evaluate the effectiveness of an exercise program in women with rheumatoid arthritis taking low dose prednisone. J Rheumatol 2000; 27:1674–1680.

16 Yang DJ, Xu FY, Gan JH. Assessment of curative effect of aerobic exercise with quality of life questionnaire for patients with rheumatoid arthritis. Zhongguo Linchuang Kangfu [Chinese J Clin Rehab] 2005; 9:150–151.

17 Bilberg A, Ahlmen M, Mannerkorpi K. Moderately intensive exercise in a temperate pool for patients with rheumatoid arthritis: a randomized controlled study. Rheumatology (Oxford) 2005; 44:502–508.

18 Suomi R, Collier D. Effects of arthritis exercise programs on functional fitness and perceived activities of daily living measures in older adults with arthritis. Arch Phys Med Rehabil 2003; 84:1589–1594.

19 Stenstrom CH, Minor MA. Evidence for the benefit of aerobic and strengthening exercise in rheumatoid arthritis. Arthritis Rheum 2003; 49:428–434.

20 de Jong Z, Munneke M, Lems WF, *et al.* Slowing of bone loss in patients with rheumatoid arthritis by long-term high-intensity exercise: results of a randomized, controlled trial. Arthritis Rheum 2004; 50:1066–1076.

21 de Jong Z, Munneke M, Zwinderman AH, *et al.* Long term high intensity exercise and damage of small joints in rheumatoid arthritis. Ann Rheum Dis 2004; 63:1399–1405.

22 Munneke M, de Jong Z, Zwinderman AH, *et al.* Effect of a high-intensity weight-bearing exercise program on radiologic damage progression of the large joints in subgroups of patients with rheumatoid arthritis. Arthritis Rheum 2005; 53:410–417.

23 Williams AE, Rome K, Nester CJ. A clinical trial of specialist footwear for patients with rheumatoid arthritis. Rheumatology (Oxford) 2007; 46:302–307.

24 Woodburn J, Barker S, Helliwell PS. A randomized controlled trial of foot orthoses in rheumatoid arthritis. J Rheumatol 2002; 29:1377–1383.

25 Chalmers AC, Busby C, Goyert J, *et al.* Metatarsalgia and rheumatoid arthritis–a randomized, single blind, sequential trial comparing 2 types of foot orthoses and supportive shoes. J Rheumatol 2000; 27:1643–1647.

26 Fransen M, Edmonds J. Off-the-shelf orthopedic footwear for people with rheumatoid arthritis. Arthritis Care Res 1997; 10:250–256.

27 Mejjad O, Vittecoq O, Pouplin S, *et al.* Foot orthotics decrease pain but do not improve gait in rheumatoid arthritis patients. Joint Bone Spine 2004; 71:542–545.

28 Pagnotta A, Baron M, Korner-Bitensky N. The effect of a static wrist orthosis on hand function in individuals with rheumatoid arthritis. J Rheumatol 1998; 25:879–885.