Physical therapy for older adults with arthritis: what is recommended?

With the exponential growth of the aging segment of the population, physical therapy clinics are treating larger proportions of patients with arthritic conditions. Arthritis is a leading cause of functional restrictions and disability due to its associated pain, inflammation, cardiovascular and pulmonary involvement. These symptoms overlaid upon normal age-related declines in the musculoskeletal, neuromuscular, integumentary and cardiopulmonary systems place older adults with arthritis at higher risk of disability and loss of independence. Physical therapy interventions are recognized as an integral component of arthritis management and their benefits have been well documented. This article reviews the common findings of the physical therapy examination and evidence for physical therapy interventions for select arthritic conditions.

KEYWORDS: aging benefits physical therapy rheumatic diseases

Arthritis and musculoskeletal disorders are widespread and may result in joint pain, soft tissue contracture, restrictions in joint movement and activities of daily living, deformity, disability [1] and, in some instances, death [2]. Physiologic manifestations of arthritis, such as joint capsule thickening, inflammation, muscle atrophy and reduced cardiopulmonary reserve, are exacerbated with physical inactivity and may be compounded with side effects of pharmacotherapy. Unfortunately, approximately 70% of older adults in the USA report no regular exercise and among older adults with arthritis, the rates of leisure time physical activity are 7% lower than their healthy counterparts [3].

There are more than 100 rheumatic conditions, of which the most common form is osteoarthritis (OA). Osteoporosis may be present at any age, but is more prevalent in older adults. Polymyalgia rheumatica (PMR) presents with advancing age, while ankylosing spondylitis (AS) often presents early in life. Diseases such as systemic lupus erythematosus (SLE) and rheumatoid arthritis (RA) may present early (patients aged in their 30s and 40s) or have a late onset (age of 55 years and older). The systematic and local manifestations of these conditions are compounded by the normal aging process and influence the physical therapy management of older adults with arthritis [2].

Normal changes with aging
In brief, changes with aging are evident across all systems of the human body and produce concurrent changes in physical performance over time. In the musculoskeletal system, muscle force production reaches its peak in the second and third decades of life and declines with age. Loss of motor units and reduction in muscle mass are associated with changes in protein synthesis and mitochondrial enzyme activity, leading to decreased strength [4]. Neurosensory changes result in diminished proprioception, disturbances in balance, reduced response to external challenges and increased risk of falls. In addition, cardiovascular and pulmonary systems become less efficient, resulting in declining stroke volume, vital capacity and exercise performance. Thus, older adults perform activities of daily living at a higher percentage of their physiologic reserve. However, these changes can be attenuated with exercise. A recent systematic review of 13 studies of exercise on musculoskeletal function in healthy older adults [5] reported strong evidence for the use of resistance training (three to four sets at 60–80%, one repetition maximal force production) for improving strength and muscle mass among healthy older adults. Among persons with arthritis, these recommendations require modifications to adjust for variations in physiologic condition and response to exercise, especially in light of the changes in physiologic reserve and function.

Physical therapy interventions & management
Physical therapists are licensed healthcare professionals who provide interventions to address the prevention, diagnosis and treatment of movement dysfunctions and to improve physical...
health and function [6]. In the USA, physical therapists earn a university degree prior to matriculating into either a professional master or doctoral degree program. This level of education is not the norm worldwide. In some countries, physical therapy education is offered at the bachelor’s level. While educational requirements vary across the globe, internationally the profession of physical therapy is evolving and educational requirements for programs are advancing.

Physical therapists provide interventions, such as therapeutic exercise, joint mobilization, physical modalities (e.g., heat, cold, electrical stimulation and ultrasound), gait training, assistive devices and orthotics, and combine these interventions with behavioral strategies and patient education to promote self-management and to maximize function and independence [6]. Interventions are individualized based upon a comprehensive physical examination and current pharmacologic management. Knowledge about the potential side effects of medications, as well as the latency period to effectiveness of medications, is essential when designing the intervention to ensure patient comfort and safety and to appropriately advance the regimen. Using a collaborative model of practice, physical therapists work with their patients to establish goals to decrease pain, maximize joint mobility, increase muscle strength, maintain and improve flexibility and aerobic capacity, and prevent functional loss. The following sections briefly describe the focus of the physical therapy assessment and the evidence for effectiveness of physical therapy interventions for older adults with arthritis.

**Rheumatoid arthritis**

Rheumatoid arthritis is a chronic, systemic autoimmune inflammatory disorder that affects approximately 1% of the world’s population [7]. While early-onset RA has a higher female:male ratio, elderly-onset RA has a more equal distribution between genders, potentially due to the hormonal changes with menopause [8]. The predominant pathology of RA is synovial inflammation. Patients may present with fever, joint pain and swelling, capsular tightening, extra-articular edema and soft tissue shortening with resultant restricted range of motion and muscle contractions.

**Joints affected & systemic features**

The clinical presentation of RA is symmetrical joint involvement. With elderly-onset RA, the most commonly affected joints are the larger weight-bearing joints, such as the hips and knees [8], although the wrists, metacarpophalangeal and proximal interphalangeal of the hands, feet, ankle and spine (cervical > thoracic or lumbar) may be involved. RA-related deformities in the feet include hallux valgus, loss of plantar fat pads, weakening of the longitudinal ligament and reduced arches, forefoot splaying, hammer toes and valgus hindfoot [9]. These impairments can lead to pain, gait deviations and excess energy expenditure during gait when coupled with muscle contractions of the large weight-bearing joints.

Systemic features of the disease include the cardiovascular, pulmonary, integumentary and nervous systems. These manifestations may be more pronounced in elderly-onset disease [8]. The increased cardiovascular risk in older adults with RA [10] indicates the need for strict and regular monitoring of cardiovascular response during exercise. The impairments associated with RA may lead to severe limitations in physical function, gait deviations, deformity, loss of independence, disability and may shorten life expectancy (Table 1) [10,11].

**Physical therapy assessment**

Physical therapy interventions are formulated based on the findings from a comprehensive physical examination (including presence of comorbidities), acuity of symptoms (acute exacerbation, subacute stage or stable disease), severity of joint destruction, global functional classification and patient preferences for treatment [12]. Three classification systems are used to describe the impact of RA, they include: function status, acuity of symptoms and severity of joint destruction [13,14].

In RA a history and physical examination is conducted focusing primarily on the cardiovascular, musculoskeletal, integumentary and pulmonary systems. Gait and functional assessments are cornerstones of the assessment. The gait analysis should include assessment of stride length, stride width, length of time in single and double stance, assessment of the joint movement and the fluidity of movement during gait. Gait mats are an easy and efficient way to assess stride length and width in the clinic.

**Management of patients with acutely inflamed joints**

During an acute flare the physical therapy assessment may reveal fever, fatigue and hot, red, swollen joints. Muscle pain, weakness and stiffness suggests myositis. If myositis is present, active exercises with resistance should be avoided.
Table 1. Onset, pathology, physical examination findings and recommended physical therapy interventions for systemic lupus erythematosus, rheumatoid arthritis, osteoarthritis, osteoporosis, ankylosing spondylitis and polymyalgia rheumatica.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Pathology and onset</th>
<th>Physical findings</th>
<th>Physical therapy interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systemic lupus erythematosus</td>
<td>Systemic inflammation of multiple organ systems; Onset: early or late (&gt;55 years)</td>
<td>Fatigue and malaise; Reduced cardiovascular reserve; Arthralgias uncommon; Coronary artery disease</td>
<td>Fatigue management; Progressive aerobic exercise (60–80%) to enhance endurance, frequent monitoring of vital signs during exercise; Dynamic strengthening exercises of moderate intensity (two to three times per week)</td>
</tr>
<tr>
<td>Polymyalgia rheumatica</td>
<td>Myositis and vaculitis; Onset: seventh decade of life</td>
<td>Proximal muscle pain and stiffness; Stiffness worse in the morning and with physical inactivity; Swelling of distal hand joints atypical; Fatigue – primary complaint</td>
<td>Active disease: – Active and passive stretching exercises – Activity modification – Patient education (assistive devices if needed) Stable disease: – Strengthening exercises (eight to ten reps) especially to shoulder and hip girdle muscles. Dynamic balance and core stability exercises – Aerobic exercises using 60–80% of age-predicted heart rate as standard or modify based on individual cardiovascular health. Progress as tolerated – Education about fall risk and strategies to reduce falls and increased physical activity</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>Deterioration of bone leading to decreased bone mass and fragility; Onset: any age in presence of corticosteroids and poor nutrition; Prevalence increases with age</td>
<td>Reduced stature; Postural changes including decreased lordosis, reduced flexibility of the shoulder and hip girdle muscles; Decreased aerobic capacity; Dynamic instability may be present</td>
<td>Strengthening exercises with low and moderate resistance depending on physical examination findings; Low impact aerobic exercise, avoid high-impact exercises in frail adults; Core stability and functional exercises; Balance activities; Flexibility and postural exercises for shoulder and pelvic girdle; Education about fall risk and strategies to reduce falls and increased physical activity</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>Synovitis; Vasculitis; Onset: early or late (&gt;55 years)</td>
<td>Bilateral and symmetrical polyarticular joint involvement; Joint pain, inflammation; Joint stiffness; Contractures may be present; Crepitus; Fatigue often underappreciated; Muscle weakness</td>
<td>Acute exacerbation: – Active ROM exercises (two reps/joint/day) – Frequent rest to address fatigue – Orthoses and splints for supportive and neutral joint position – Isometric exercises (6-s hold, four reps) Subacute: – Active ROM exercises: 8–10 repetitions/joint/day – Isometric exercises four to six contractions – Light resistance dynamic exercises (avoid if joints are unstable, in presence of tense popliteal cysts or internal joint derangement) – Aerobic exercise in pool or on land for 15–20 min (three times/week). – Cardiac evaluation is recommended. Establish heart rate parameters and use perceived rating of exertion scale Stable disease: – As above, but increase aerobic activities</td>
</tr>
</tbody>
</table>

BAPS: Biomechanical ankle platform system; Rep: Repetition; ROM: Range of motion.
Adapted from [75].
The physical therapy intervention during an acute flare includes patient education regarding energy conservation, maintenance of joint range of motion, gentle isometric exercises and proper joint positioning. Stretching of soft tissue is avoided. Range-of-motion exercises and gentle isometric exercises are prescribed to maintain joint range and increase strength [15–17]. Resting splints help maintain a neutral position and protect joints during sleep while dynamic splints help to unload the joints and control joint movement during daily activities. The evidence for splinting suggests modest effectiveness for pain reduction and improved manipulation of objects and grasp [18]. Physical modalities may be incorporated into therapy sessions in order to reduce swelling and discomfort. According to the Ottawa Panel Evidence-based Practice Guidelines [19], the use of low-level laser, thermotherapy and transcutaneous electrical nerve stimulation are the most effective agents to address joint pain and swelling. Patients with gait and foot abnormalities can be helped with the use of orthotics, adaptive footwear and training in the use of assistive devices. Orthotics and adaptive footwear are designed to redistribute weight, maintain alignment and reduce pressure on the joints. In the presence of foot and lower extremity deformities, platform attachments to assistive devices may be indicated. Gait training focused on correction of abnormal movements and appropriate weight shift during gait may reduce energy expenditure and facilitate more fluid movement. Orthotics improve function and pain, but are less effective for modifying gait deviations [20,21].

### Table 1. Onset, pathology, physical examination findings and recommended physical therapy interventions for systemic lupus erythematosus, rheumatoid arthritis, osteoarthritis, osteoporosis, ankylosing spondylitis and polymyalgia rheumatica (cont.)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Pathology and onset</th>
<th>Physical findings</th>
<th>Physical therapy interventions</th>
</tr>
</thead>
</table>
| Osteoarthritis                | Cartilage degeneration; Onset: insidious | Stiffness and pain predominantly in large weight-bearing joints; Joint malalignment present; Weakness especially of quadriceps; Joint instability/hypermobility; Abnormal patella tracking with retropatellar pain | Mild disease:  
  - Active ROM exercises with daily activities, three to five reps of flexibility exercise and eight to ten reps of static exercises, each of 6-s duration  
  - Dynamic exercises, especially to quadriceps and hamstrings (eight to ten reps);  
  - Low-effect aerobic exercises (aquatic and bicycling) 20 min, three times per week  
  - Balance activities (BAPS and tilt board), single-limb stance  
  Moderate:  
  - Static and dynamic exercises – reduce to five reps, three to five reps of flexibility exercises  
  - Low-effect aerobic exercises (aquatic, bicycling – 20 min, three times/week); balance and proprioception activities – bilateral  
  - Use of cane or lateral heel wedge foot orthosis, neoprene knee sleeve  
  Severe disease:  
  - Low- to no-effect aerobic exercises (aquatic)  
  Note: advise functional activities to keep moving, few to no reps of dynamic exercises; patient education is very important  
  Note: in patients with ligamentous laxity and malalignment, caution should be taken with prescribing quadriceps strengthening exercises; orthoses, crutches or walkers |
| Ankylosing spondylitis        | Endotheliasis; Onset: 15–30 years of age | Stiffness and pain in axial spine, sacrum, sometimes involves hips and shoulders | Flexibility and spinal mobility exercises, postural re-education, aerobic exercise to maintain pulmonary function |

BAPS: Biomechanical ankle platform system; Rep: Repetition; ROM: Range of motion.

Adapted from [75].
walking programs, dance, cycling and dynamic exercises with resistance. The use of high-impact exercise to manage RA is still unclear. Data published from the Rheumatoid Arthritis Patients In Training (RAPIT) trial examining the outcomes of patients at various end points and by subgroups, suggest that high intensity exercise may have some benefits on the small joints of the feet, but not for those who had pre-existing joint involvement [23–26]. In current clinical practice, weight-bearing exercise in the presence of joint derangement and cartilage loss are avoided.

Aquatic exercises are commonly prescribed to facilitate joint movement by reducing the load on joints and by reducing muscle spasms. The recommended water temperature is 37–40°C [12]. A recent randomized, controlled study by Suomi and Collier demonstrated improvements in function and strength with an 8-week aquatic exercise program offered for 45 min, twice a week, compared with usual activity [27]. Persons allocated to the land exercise demonstrated similar benefits to those in the pool. These results are supported by another randomized, controlled trial in which patients were allocated to either 12 weeks of aquatic exercise of moderate intensity for 45 min, twice a week or land exercises of the same intensity, frequency and duration [28]. Both groups demonstrated improvements in aerobic capacity and function. As results are similar between land and aquatic exercise, patient preference should inform the intervention choice.

Patient education & rheumatoid arthritis
Patient education is a cornerstone of chronic disease management, particularly in RA where the disease course is unpredictable and strategies to manage symptoms differ depending on the acuity of the symptoms. Physical therapists educate patients in energy conservation techniques, exercises to use during flares, how to determine the appropriate intensity of exercise, and when to incorporate dynamic strengthening and aerobic exercises after symptoms subside. A recent systematic review of patient education in RA found statistically significant modest benefits for reduced functional disability (effect size: -0.17). While this result was short-lived, the effect is similar to those reported for certain disease-modifying agents [29].

Systematic lupus erythematosus
Systemic lupus erythematosus is a disease of unknown etiology that is commonly identified in women during their childbearing years. However, SLE has been demonstrated to present in later life (age > 55 years) [30]. Environmental factors, such as exposure to ultraviolet light, petrochemicals, mercury and certain infectious agents, impact gene expression in susceptible hosts. While early-onset SLE is three- to four-times more prevalent in African-Americans, this racial differential in presentation is less pronounced with later-onset disease [30].

Joints affected & systemic features
Whether early or late in onset, SLE may affect the joints, skin, kidneys, heart, lungs, brain and gastrointestinal tract. Arthralgias and joint involvement are less prevalent in SLE compared with other arthritic conditions. If joint involvement is present, the most common joints involved are the hips. Avascular necrosis of the hip is also a potential concern. The systemic features of SLE are the primary limiting factors in functional performance and independence. Coronary heart disease is a major cause of mortality. In fact, persons with SLE are 9–11-times more likely to die from coronary heart disease compared with their healthy counterparts [30]. Fatigue is a primary complaint and may result from myositis, anemia, deconditioning, depression, cardiovascular or pulmonary involvement.

Physical therapy assessment & intervention
During the comprehensive physical therapy assessment the primary focus is typically the cardiovascular and pulmonary systems. The musculoskeletal assessment may suggest muscle weakness and low endurance. As always, the physical examination findings inform the intervention. Most frequently, cardiovascular endurance, fatigue and pulmonary findings lead to the development and implementation of an aerobic conditioning program of cycling, walking or dynamic exercises. Individuals diagnosed with SLE may have asymptomatic cardiovascular disease. As such, vital signs should be taken at baseline and during each phase of exercise progression. Prolonged warm-up and cool down periods are also important for the older adult with SLE to allow the body to adapt to exercise. Brief (15 min), low-intensity exercise sessions twice a day can be used to promote exercise tolerance in persons who are severely deconditioned. In the presence of avascular necrosis of the hips, aquatic exercises can be employed to reduce joint loading and improve joint mobility, muscular strength and aerobic capacity. Individuals with hip involvement may also require assistive devices to unload joint while ambulating.
Evidence for the benefits of exercise to manage SLE

While there are no studies specifically examining the use of aerobic exercise in persons with SLE aged 55 years and older, a recent review of exercise for SLE summarized the data from six clinical trials [31]. The study designs employed included randomized and controlled clinical trials, and included mostly women with mild-to-moderate disease activity. Interventions included cycling, walking, swimming and strengthening exercises. Some interventions were supervised and others were not. Treatment durations ranged, on average, from 8 to 12 weeks, with one study lasting 36 weeks. Patients were instructed to exercise three times per week for 30–60 min. Most exercise prescriptions were set at a moderate intensity (60–80% of heart rate) and one was individually tailored. In all trials, disease activity remained stable. In four trials, benefits were reported in V02 max, self-reported fatigue and function. Two trials reported no significant differences in outcomes between treatment and control groups. Despite the heterogeneity in methodology, these results indicate that exercise is well tolerated and yielded positive results in persons with SLE.

Polymyalgia rheumatica

Polymyalgia rheumatica is one of the most prevalent systemic inflammatory rheumatic diseases in the elderly, with an average age of onset of 70 years [32]. Women are more often affected than men. While the etiology is unclear, the dominant pathology is vasculitis. PMR is associated with giant cell arteritis in 10–20% of patients [33]. Often erythrocyte sedimentation rate and C-reactive protein concentrations are elevated. Elevated erythrocyte sedimentation rate and C-reactive protein in the presence of physical symptoms indicate an acute flare. A rapid response to corticosteroids is often considered a classic feature of PMR, as well as a diagnostic criterion [32]. Unfortunately, steroids may also mask other pathologies [32,34]. Recent practice guidelines recommend close monitoring for early response to steroids in order to rule out serious pathologies. These guidelines also recommend incorporating osteoporosis prevention strategies for patients on long-term steroid management in order to prevent osteoporosis-related fractures, disability and death [32].

Joints involved & systemic features

The primary physical complaint in PMR is proximal muscular pain and stiffness lasting more than 45 min [32,34,35]. Fever, malaise and weight loss are common. Stiffness is worse in the mornings and on exertion, and prolonged physical inactivity can exacerbate symptoms [35]. Tenderness of the distal hand joints and swelling may be evident. Diffuse muscular tenderness and morning stiffness can severely limit physical function and activities of daily living.

Physical therapy assessment

A comprehensive musculoskeletal and cardiovascular pulmonary assessment is warranted. Typically, the results of the physical assessment will indicate pain, stiffness and weakness of the hip and shoulder girdle muscles, leading to difficulties with activities of daily living and transfers. Patients may report and demonstrate difficulties with sit-to-stand transfers, stair climbing and gait. Gait abnormalities may include antalgic gait, reduced single-limb stance and decreased velocity.

Physical therapy interventions

While there are no documented studies of the efficacy of physical therapy for PMR, physical therapy interventions are designed to reduce discomfort, prevent soft tissue contractures, maximize function and independence during acute flares, and reduce the fall risk. During an acute flare, patients may be instructed in the use of an assistive device, as weakness and balance disturbances may contribute to dynamic instability. Patient education is provided to assist in fatigue management and provide reinforcement of the use of flexibility exercises. Once the myositis subsides, therapy is directed toward maximizing muscle strength, addressing potential alterations in posture and gait and toward reducing contractures. Passive and active stretching of muscles using a 60-s hold is employed to regain soft tissue flexibility and joint range of motion [36]. Owing to severe stiffness, pain and weakness, proximal strength is diminished and can be improved with core stability exercises and balance activities. These activities can be progressed from the supine position (bridging) to standing and eventually to gait activities (tandem walking) [12].

Polymyalgia rheumatica-associated fatigue and malaise generally result in reduced pulmonary function and deconditioning. A progressive aerobic conditioning program can be used to maximize aerobic capacity and regain physical functioning in the home and community. In order to ensure safety and to monitor cardiovascular response to exercise, vital signs should be monitored at rest, at completion of the...
exercise session and following changes in workload. Bicycle endurance training is preferred when initiating aerobic training due to proximal muscle weakness and dynamic instability. Instruction in self-management and education regarding the disease and signs of flare are paramount. As some patients may continue long term on low-dose corticosteroids [32], it is important to address home safety and fall risk factors as bone integrity may be affected (Table 1).

**Osteoporosis**

Osteoporosis is a metabolic disease that leads to bone loss and deterioration of bone tissue, increasing the risk of fractures [101]. Risk factors for osteoporosis include a history of smoking, early menopause, slight build, medications such as steroids, and genetics. Older adults who experience a fracture are at higher risk of disability and death [37]. Physical therapy can help patients maintain an active and independent lifestyle and is provided to help rehabilitate persons following a fracture.

- **Joints involved**
  - While bone integrity can be compromised throughout the body, the joints typically involved are the hips, wrists and spine [101]. Osteoporosis has also been associated with diminished aerobic capacity and muscular force production [38].

- **Physical therapy assessment & interventions**
  - The physical assessment may reveal postural abnormalities, such as kyphosis, reduced lumbar lordosis, forward head and rounded shoulders. Muscle strength may be diminished and pain may be evident on palpation and with movement in the presence of a fracture. Persons with osteoporosis may also demonstrate reduced aerobic capacity due to physical inactivity [38]. In the absence of a fracture, gait deviations, such as reduced gait velocity, may be observed due to fear of falling.

  - Physical therapy interventions are typically designed to maximize muscle strength, improve flexibility and posture, address balance and gait deviations, and educate about the disease and fall risks in order to prevent future fractures and maintain function. The constellation of interventions for persons with osteoporosis is broad. Exercises are used to enhance muscle force production, improve core stability, improve gait and cadence, and correct postural deviations. Static, dynamic and functional exercises are used in combination to achieve goals of treatment. Guidelines for physical activity published by the National Osteoporosis Foundation (NOF) provide a framework for patients to maintain bone health [101]. The NOF recommends 30 min of weight-bearing exercises, such as brisk walking, running and stair climbing, two to three times per week [101]. The use and amount of resistance during dynamic exercises with older adults is determined by the results of the physical examination. Persons with osteoporosis may limit their physical activity due to fear of falling leading to greater risk of deconditioning. Patient education should include fall risk strategies to reduce the risk of falls within and outside the home as well as strategies to promote physical activity. The National Center for Injury Prevention provides free home safety checklists to consumers and exercise tips [102].

- **Evidence for effectiveness of interventions**
  - Most studies examine the effects of exercise in combination with calcium and vitamin D on bone integrity and physical function. While bisphosphonates and supplements are proven to be effective [39], the combination of vitamin supplements with exercise appears to yield the greatest benefits [40,41]. Korpelainen *et al.* conducted a randomized, controlled trial of supervised exercise and education in 120 women (mean age: 72 years) who were identified as having low bone mineral density (BMD) [40]. Patients were allocated to either a 6-month exercise program versus control. Patients allocated to the exercise participated in supervised impact exercises and balance activities for 60 min for 6 months followed by a home exercise program performed for 20 min over 6 months. At 30-month follow-up, while BMD declined over time, individuals participating in the exercise program had significantly less decline in BMD compared with controls. Subjects enrolled in the control group also suffered more fall-related fractures than the exercisers. Yamazaki *et al.* enrolled 50 postmenopausal women with osteopenia/osteoporosis in a 1-year clinical trial of brisk walking and dietary consultation versus no exercise and dietary advice to determine the impact of the intervention on BMD [41]. The mean age of the women evaluated was 64.8 years. Patients enrolled in the exercise group were instructed to walk at a set speed for 1 h, four times per week. Women in both groups were advised to ingest more than 800 mg of calcium/day. At initial follow-up, the exercise group demonstrated a slight gain in BMD (1.7%) while BMD in the control group declined (-1.9%).
Osteoarthritis
Osteoarthritis is a complex multifactorial disease. Approximately 11% of persons over 64 years of age have symptoms of OA [42]. OA is classified as primary (insidious) or secondary (result of other disease or trauma) and leads to cartilage degradation. Eventually, the bone and periaricular structures are affected [43–45]. Risk factors for the development of OA include obesity, joint trauma, malalignment and quadriceps weakness in the presence of ligament laxity [46,47].

Joints involved
The hips, knees, spine and hands (distal and proximal interphalangeal joints, the carpometacarpal joint and first metatarsal phalangeal joint) are often involved [42]. Early in the disease course, focal lesions of the hyaline cartilage may be present owing to biomechanical (abnormal or excessive joint loading) and chemical factors (cytokines). Patients report stiffness of short duration in the morning (<30 min) or after prolonged sitting or inactivity. Weight-bearing and increased physical activity produce pain [12]. As the cartilage destruction progresses, the subchondral bone is affected. Over time, joint deformity, soft tissue contracture, malalignment and instability of the joint may present (Table 1).

Physical therapy assessment & interventions
A comprehensive musculoskeletal evaluation may reveal joint mobility restrictions, decreased muscular strength, pain and stiffness. Crepitus may be felt on examination of the joint with passive range of motion [42,44]. With advanced cartilage loss, localized joint and soft tissue swelling and night pain may be evident [47].

Osteoarthritis is described based on the joints involved. Spondlysis or OA of the spine may involve any spinal segment and results in reduced range of motion, stiffness and pain with movement. The presence of spinal osteophytes may produce nerve compression and radicular symptoms. OA of the hip may limit hip internal rotation and adduction. Hip pain may be dull or sharp pain and localized to the joint line, or may be referred to the buttock, groin, thigh or knee [12]. Gait and activities of daily living are impacted. With OA of the hand, Herberden’s nodes may be observed at the distal interphalangeal joints and/or Bouchard’s nodes at the proximal interphalangeal joints. Involvement of the carpometacarpal joint produces pain, swelling and limitations in grip strength and activities of daily living (e.g., opening jars and turning door handles) [43]. Individuals diagnosed with knee OA, the most common form of OA, present with complaints of knee instability or buckling during joint loading activities (e.g., stair climbing). Varus or valgus of the knee may be present, although varus is more prevalent. These deformities result from muscle weakness and contractures and increase biomechanical forces across the joint. During the examination, abnormal patella tracking may be observed and is associated with retropatellar pain. Limitations in joint range of motion are common.

Physical therapy interventions for knee OA include physical modalities, such as heat and ultrasound, to increase soft tissue extensibility, range of motion, strengthening and aerobic exercises, joint mobilization and manipulation, patient education (use of assistive devices and weight reduction) gait training and use of orthotics. The evidence for effectiveness of thermotherapy (heat and ultrasound) is currently not supported by the literature [48], but is often used clinically as an adjunct to therapy. Exercise for the management of OA is recommended by numerous professional societies [48–51]. The evidence for exercise in OA is most abundant for managing symptoms of knee OA [52,53]. The specific intensity, frequency, duration and mode is not clearly articulated, rather the evidence for effectiveness of exercise is described. In a report published by the Osteoarthritis Research Society International (OARSI), experts in orthopedics, rheumatology and research methodology, evaluated current published guidelines and literature on the effectiveness of interventions to manage hip and knee OA [48]. In addition to describing the quality and scope of these guidelines, the authors reported effect sizes for exercise indicating significant and moderate effect sizes for strengthening exercises (effect size [ES]: 0.32; 95% CI: 0.23–0.42) moderate effect size for aerobic exercise (ES: 0.52; 95% CI: 0.34–0.70) and small effect size for aquatic exercise (ES: 0.25 95% CI: 0.02–0.47) [48].

Strengthening exercise regimens include resistance exercise to improve quadriceps, functionally based exercises such as controlled, repeated sit-to-stand exercises, closed chain exercises to address proximal stability and reduce joint stress [53–55]. Dynamic balance activities may include single-leg standing, weight-shifting activities and use of rocker boards and gait training on uneven surfaces are used to facilitate co-contraction around the joint and improve
joint position awareness. In persons with lax or malaligned knees, exercise proper positioning and avoidance of joint stress is needed to prevent exacerbation of symptoms [47].

Proper alignment of the joint during exercise is important to reduce joint stress. The use of an unloader-type orthoses at the knee or lateral wedge insoles can help to minimize medial compartment pressure at the knee. Weight loss is recommended to reduce joint load and relieve pain. In a well-described systematic review and meta-analysis of weight reduction programs for persons with knee OA, Christensen et al. pooled the data for four clinical trials and found low but significant effects for weight loss of 6.1 kg (range: 4.7–7.6 kg on self-reported pain and disability; ES: 0.2 and 0.3, respectively) [56]. If the weight loss exceeded 5.1%, then the beneficial impact on physical disability increased. When weight loss is combined the results are more pronounced [57]. Considering the impact of excessive weight on joint loading at the knee, weight loss should be encouraged prior to initiating high-impact exercise programs.

Interventions for hip OA are less well studied, but include similar components. Joint mobilization is used clinically, but the evidence for effectiveness is limited. In a randomized, controlled 5-week trial of manual therapy versus exercise, Hoeksma et al. enrolled 109 outpatients with hip OA [58]. Patients allocated to the manual therapy program received specific manipulations and mobilization of the hip joint. Those allocated to exercise performed active exercises, including stretching, range-of-motion and resistive strengthening exercises to improve muscle function and joint motion. At the end of the intervention period, patients in the manual therapy group were 92% more likely to report improvement compared with the exercise group (OR: 1.92; 95% CI: 0.30–2.60). The manual therapy group reported significantly greater reduction in hip pain, stiffness, function and range of motion. In a well-designed review of exercise to manage hip pain, Hernandez-Molina also reported moderate benefits in pain reduction with exercise of varying frequency, intensity and duration (Figure 1) [59]. In another review, benefits of strengthening exercise for hip OA were found for pain but not disability [53].

Aerobic exercise programs for individuals with hip or knee OA when performed at moderate intensity, for 20–30 min, three to four times per week, have been demonstrated to improve endurance and reduce fatigue, and increase muscle strength [53–55]. These interventions generally include brisk walking, swimming or cycling. A combination of modes of exercise may

---

**Figure 1.** Meta-analysis of exercise versus no exercise on pain in persons with hip osteoarthritis.

Data taken from [59].
help reduce boredom and enhance adherence. For persons with severe cartilage loss, aquatic programs are well tolerated.

### Anklyosing spondylitis

Anklyosing spondylitis is a chronic systemic inflammatory disorder diagnosed most commonly in younger men. Disease activity is more active in the first decade of diagnosis but may persist for many years [60]. AS involves inflammation of the tendons and ligaments at their insertion. Involvement of the heart and lungs is common [61]. Inflammation of the joints can lead to debilitating pain and with time potential spinal fusion, loss of motion and reduced rib excursion.

#### Joints involved & systemic features

The primary joints affected with AS include the axial skeleton and sacroiliac joints, but the shoulders and hip joints may also be involved. Persons with AS typically present with morning stiffness, and pain that worsens with inactivity and is relieved with movement. Fatigue is prevalent in approximately half of patients [62]. Systemic features of AS include mitral valve prolapse and kidney disease.

#### Physical therapy assessment & interventions

A comprehensive cardiopulmonary and musculoskeletal evaluation includes assessment of chest expansion, cardiovascular and pulmonary function, posture, and spinal and sacral mobility. Patients’ chief complaints are stiffness, fatigue and respiratory restrictions. Spinal mobility can be assessed with Schober’s test or standard inclinometer. Spinal mobility restriction is one of the earliest signs of disease and progresses with time. Elderly patients with long-standing disease often exhibit little to no lumbar lordosis, hip flexion contractures, and restricted spinal mobility in all planes, especially in rotation and extension. In persons with severely restricted chest expansion and spinal range of motion, a submaximal exercise test is warranted to assess pulmonary function/perfusion.

The primary focus of the physical therapy intervention is to preserve spinal mobility, prevent or reduce deformities, and enhance muscular strength and endurance. The European League Against Rheumatism and others recommend the use of exercise to maximize function and independence [63]. Data suggest that supervised exercise programs yield greater benefits than unsupervised exercise.

Few studies examine the benefits of exercise and rehabilitation in older adults with persistent disease. Two recent reviews have evaluated the evidence for nonpharmacologic interventions to manage the symptoms of AS [63,64]. The most recent review by Nghiem described the results from six trials of rehabilitation interventions from January 2005 to July 2007 [64]. A total of four of the six studies were randomized, controlled trials. These studies included a single evaluation of balneotherapy, two studies of an experimental exercise protocol, one multimodal exercise intervention and two studies that assessed cytokine response to exercise. While the outcomes and methodology used in the trials differed, the data indicate short-term benefits with rehabilitation. Specifically, a targeted exercise program may provide greater benefits than conventional exercises both in the short and long term and the multimodal program produced some short-term benefits in function. The authors emphasized the need for standardized measures to be used in clinical trials of rehabilitation to allow comparisons across groups and evaluations of specific exercise regimens in order to determine effectiveness. In a recent study, researchers attempted to identify the attributes of patients with AS who would benefit from exercise [65]. Using a convenience sample, 35 patients with AS were consecutively enrolled and received a standardized physical examination and eight physical therapy sessions over 2 months. Exercises were designed to assess flexibility, strength and postural abnormalities. At 3 months, a successful outcome was defined as having a 20% reduction on Bath Ankylosing Spondylitis Functional Index and the patient’s report perceived recovery. A total of 46% of patients were classified as having a successful outcome. Significant predictors of success were physical role functioning, bodily pain and disease activity.

### Adherence to exercise

Exercise and physical activity require active participation of patients and, as such, their effects are proportional to the patient’s level of adherence. The literature demonstrates that adherence to short-term supervised exercise programs, defined as programs that last anywhere from 1 to 12 months, ranges from 68 to 93%. Long-term adherence rates to exercise that requires more extensive lifestyle changes are lower, in the range of 25–50%. With advancing age, adherence to exercise diminishes and is lower still among older adults with arthritis. Recent studies have examined factors associated with exercise adherence...
among persons with chronic pain [66] and arthritis (Table 2) [67–69]. Factors associated with exercise adherence include internal factors, such as self-efficacy, prior experience with exercise, attitudes, beliefs and expectations regarding the benefits of exercise for arthritis, as well as external factors, such as providers’ beliefs and attitudes toward exercise for arthritis, limited access, cost and time [66–70]. Greater frequency of exercise may be less influential than higher intensity as higher intensity exercise may result in short-term muscle soreness and stiffness.

To promote adherence physical therapy interventions and maximize outcomes of care, physical therapists should integrate patients’ preferences for treatments, address patients’ expectations of care, and attitudes and beliefs toward interventions. Goals for treatment should be established in small increments that are attainable in the established timeframe. Clinical discussions focusing on the benefits of exercise, how to address potential barriers to exercise and modify the program promote adherence. The use of an exercise log is helpful to demonstrate progress and to record difficulties with specific exercises. Social support for exercise has also been demonstrated to increase adherence, and so it is important to encourage patients to engage the assistance of a significant other to motivate them to exercise and to link patients with community-based programs [71].

Self-management programs that target patient’s beliefs, attitudes and self-efficacy for managing arthritis have proven to be effective in improving function, reducing disability and maximizing quality of life [72–74]. While physical therapists educate patients about self-management as part of their intervention, there are a plethora of community-based and internet-based, well-tested, self-management programs available to patients. The Stanford Arthritis Self-Management Program is the most well studied and successful program for persons with arthritis with demonstrated improvements in symptoms and function and reduced healthcare utilization [72–74]. Such programs are useful to augment the benefits of treatment and increase long-term compliance with management recommendations.

**Conclusion**

The clinical manifestations and impact of arthritis is compounded by the natural changes of aging. Physical therapy interventions provide

---

### Table 2. Studies of adherence to exercise in patients with arthritis.

<table>
<thead>
<tr>
<th>Study</th>
<th>Subjects and form of arthritis</th>
<th>Intervention</th>
<th>Results</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iversen et al. (2004)</td>
<td>132 patients with RA (mean age: 58.4 years) and 25 rheumatologists</td>
<td>None. Observational cohort</td>
<td>Predictors of exercise behavior at 6 months were patients’ past history of exercise (OR: 6.8; 95% CI: 3.1–15) and rheumatologists’ current exercise behavior (OR: 0.26; 95% CI: 0.09–0.77).</td>
<td>[68]</td>
</tr>
<tr>
<td>Wilcox et al. (2006)</td>
<td>68 persons with all forms of arthritis</td>
<td>None. This was a focus group study to examine barriers, benefits of exercise</td>
<td>Barriers to exercise included symptoms of arthritis, physical/environmental factors; Facilitators: past positive experience with exercise, waning of symptoms</td>
<td>[67]</td>
</tr>
<tr>
<td>van Gool et al. (2005)</td>
<td>206 overweight and obese persons with knee osteoarthritis</td>
<td>The Arthritis, Diet, and Activity Promotion Trial 18-month diet counseling and exercise session</td>
<td>60.7% diet sessions and 53.2% of the exercise sessions attended. High attendance at diet sessions associated with not being married and low social participation (months 1–4). Exercising at home predicted high attendance to exercise sessions (months 5–18). High early attendance correlated with high later attendance</td>
<td>[69]</td>
</tr>
<tr>
<td>Mayoux-Benhamou et al. (2008)</td>
<td>208 outpatients with RA</td>
<td>Control: received booklet and usual care; Treatment: 6-month multidisciplinary education with home exercise and guidelines for activity</td>
<td>At 6 months, the treatment group showed greater adherence to exercise and physical activity (13 vs 1% and 28 vs 14%). No difference at 12-month follow-up. Predictors of adherence were low activity level at baseline, less fatigue and stable mood state</td>
<td>[70]</td>
</tr>
<tr>
<td>Medina-Miraplex et al. (2009)</td>
<td>34 individuals with neck or low back pain</td>
<td>Received individual home exercise program by a physical therapist</td>
<td>Factors change when pain or disabilities appear. Beliefs about illness and treatment are more likely when pain is present. When pain decreases patients consider perceptions about barriers, social support and physical environment</td>
<td>[66]</td>
</tr>
</tbody>
</table>

OR: Odds ratio; RA: Rheumatoid arthritis.

Data presented at [76].
a comprehensive approach to the management of musculoskeletal conditions in older adults. While the benefits of all interventions have not been formally established, exercise and specific modalities have been demonstrated to improve patient-oriented outcomes. Initiated early and consistently, physical therapy aims to maximize function and independence and reduce impairments in older adults with arthritic conditions.

Future perspective
With the changing demography and growth of persons aged older than 65 years, coupled with advancing in medical therapies, we will see a stronger emphasis on evaluative research on nonpharmacologic management of older adults persons with rheumatic conditions. While the evidence is accumulating for the effectiveness of exercise in managing arthritis symptoms and improving function and quality of life, further research is needed to examine the specific impact of exercise for older adults with arthritis and to document the impact of long-term adherence to therapy. Research is needed on the effectiveness of interventions for persons with PMR and for adults with late-onset RA and SLE. Physical therapy educational programs should include more information for therapists on the types and impact of arthritis to ensure proper management of all persons with arthritis, especially older adults.

Financial & competing interests disclosure
The author has no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

No writing assistance was utilized in the production of this manuscript.

Executive summary

Consequences of arthritis & aging
- Normal changes with aging compound the impact of arthritis, placing older adults at greater risk for complications of arthritis.

Physical therapists & their role in the management of individuals with arthritis
- Physical therapists are educated to provide a comprehensive approach to the treatment and prevention of musculoskeletal disorders.
- The education of physical therapists varies across the globe and range from university education and doctorally prepared professional to professionals with a bachelorate education.
- The profession of physical therapy is evolving and education is advancing.

Perspectives on physical therapy interventions for arthritis
- There is solid evidence for the benefits of moderate intensity strengthening and aerobic exercise for persons with rheumatoid arthritis.
- Use of thermotherapy, low-level laser and transcutaneous electrical nerve stimulation for rheumatoid arthritis is supported by the literature.
- Some small but significant effects are observed for the use of splints to manage pain and improve grasp in persons with rheumatic arthritis.
- Use of orthotics for managing symptoms of knee osteoarthritis suggests improvements in pain and function, but is less conclusive for gait.
- There are few studies investigating the benefits of physical therapy for older adults with systemic lupus erythematosus and polymyalgia rheumatica.

Future directions
- More research is needed to examine the effectiveness of physical therapy for managing polyarthritis rheumatica and for late-onset systemic lupus erythematosus and rheumatoid arthritis.
- Use of joint mobilization and manipulation as a complement to exercise requires further study.

Bibliography
Papers of special note have been highlighted as:
** of considerable interest
* of interest


Physical therapy for older adults with arthritis: what is recommended?

1. **Physical Therapy for Older Adults with Arthritis:**
   - A comprehensive review of education programs and well summarized.

2. **Comprehensive review of the therapeutic exercise in the management of rheumatoid arthritis.**

3. **Systematic review of education programs and well summarized.**


6. **Articulate discussion of orthotics and exercise for osteoarthritis (OA).**

7. **Reduced aerobic capacity in patients with rheumatoid arthritis.**


12. **Important update on the medical issues impacting persons with polymyalgia rheumatica with implications for rehabilitation.**


22. **Important update on the medical issues impacting persons with polymyalgia rheumatica with implications for rehabilitation.**


26. **Comprehensive review of education programs and well summarized.**


30. **Comprehensive review of education programs and well summarized.**


33. **Impart important update on the medical issues impacting persons with polymyalgia rheumatica with implications for rehabilitation.**


**Strong methodology.


**Comprehensive review and synthesis of data on weight reduction in OA.


* Well-designed clinical trial.


* Excellent review and analysis of data on exercise for hip OA.


### Websites