Physiotherapy management of hip osteoarthritis

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Introduction

Hip osteoarthritis is a chronic disease affecting the joint and surrounding musculature resulting in structural and functional failure of the joint and causing pain, disability, and reduced quality of life. This narrative review outlines the prevalence and burden of hip osteoarthritis followed by its natural history and risk factors. Considerations for diagnosis and assessment are then covered. An overview of the principles of hip osteoarthritis management is presented together with specific physiotherapy interventions and evidence for their effectiveness. It is important to note, however, that the bulk of research regarding conservative management relates to osteoarthritis at the knee or mixed osteoarthritis populations rather than hip osteoarthritis specifically, and that results cannot necessarily be generalised from the knee to the hip given differences in biomechanics, presentation, and risk factors. There is also a paucity of research in many areas. The recommendations of clinical guidelines are therefore emphasised. The review concludes with potential directions for research to advance the field.

Prevalence of hip osteoarthritis

Hip osteoarthritis is a common condition worldwide, particularly in older individuals. The reported prevalence of hip osteoarthritis varies greatly due to differences in the definition of osteoarthritis used (radiographic, symptomatic, or self-reported) and the characteristics of the sample. A 2011 meta-analysis found 27 studies of generally good quality reporting hip osteoarthritis prevalence rates from a range of countries (Pereira et al 2011). The rates varied from 0.9% to 45% with radiographic rates higher than those using self-reported or symptomatic osteoarthritis definitions. Men and women showed similar overall prevalence: 11.5% for men and 11.6% for women. This differs from knee osteoarthritis where the disease is significantly more prevalent in women (Pereira et al 2011). In contrast to prevalence, information on the incidence of hip osteoarthritis is limited, reflecting greater methodological challenges. The meta-analysis reported only four cohort studies from the USA, Netherlands, and Norway, with cumulative incidence rates varying from 3.8% over 10 years to 33% over 8 years (Pereira et al 2011). Despite the variation in reported rates, it is apparent that hip osteoarthritis is a major public health problem, and one that is likely to worsen with the ageing of the population.

The burden of hip osteoarthritis

Osteoarthritis is a leading cause of musculoskeletal pain and disability. The most recent Global Burden of Diseases study, published in The Lancet in 2012, found that, of the musculoskeletal conditions, the burden associated with osteoarthritis is amongst the most rapidly increasing (Vos et al 2012). Hip osteoarthritis is extremely debilitating for affected individuals. Pain is a dominant symptom, becoming persistent and more limiting as disease progresses. Patients with hip osteoarthritis also report difficulty with functional activities such as walking, driving, stair-climbing, gardening, and housekeeping (Guccione et al 1994) as well as higher levels of anxiety and depression (Murphy et al 2012). Work productivity is affected with greater absenteeism, while fatigue and sleep problems are common (Murphy et al 2011). Furthermore, people with osteoarthritis typically suffer from a range of co-morbid diseases that further increases their likelihood of poor physical function (Guh et al 2009).

Hip osteoarthritis imposes a substantial economic burden, with most costs related to a range of conservative and surgical treatments, lost productivity, and substantial loss of quality of life (Dibonaventura et al 2011). In particular, rates of costly hip joint replacement surgery for advanced disease are increasing including a shift in the demographic of recipients to younger patients (Australian Orthopaedic Association National Joint Replacement Registry 2012, Ravi et al 2012). Clearly hip osteoarthritis is associated with considerable individual and societal burden and, given that there is currently no cure for the disease, treatments that reduce symptoms and slow functional decline are needed.

Risk factors and natural history

The development of hip osteoarthritis results from a combination of local joint-specific factors that increase load across the joint acting in the context of factors that increase systemic susceptibility (Figure 1). Age is a well-established risk factor for hip osteoarthritis as are developmental disorders such as congenital hip dislocation, slipped capital femoral epiphysis, Perthes disease, and hip dysplasia (Harris-Hayes and Royer 2011). More recently, femoracetabular impingement, which refers to friction between the proximal femur and acetabular rim due to abnormal hip morphology and is seen in younger active individuals, has been implicated as increasing the risk of hip osteoarthritis (Harris-Hayes and Royer 2011). Caucasians appear to have a higher prevalence of hip osteoarthritis compared to Asian, African, and East Indian populations. Albeit based on limited or inconsistent evidence, hip osteoarthritis also appears to be associated with obesity, occupations involving heavy lifting and farming, high volume and intensity of training particularly in impact sports, and leg length discrepancy (Suri et al 2012).

The natural history of hip osteoarthritis shows that radiographic deterioration over time is common although the rate of progression varies from person to person. Risk factors for disease progression can differ from those of disease onset. A 2009 systematic review summarising the results of 18 prospective cohort studies found strong evidence that age, baseline hip pain, and several radiographic features were predictive of the progression
of hip osteoarthritis, while there was weak evidence of no association with body mass index (Wright et al 2009). The role of modifiable biomechanical and neuromuscular factors such as muscle weakness in predisposing to development of hip osteoarthritis has not been investigated.

A limited number of studies have evaluated the course of functional status over time in people with hip osteoarthritis. For studies with follow-up durations of three years or less, pain and functional status appear to be relatively stable on a population level although considerable individual variation occurs. With follow-up of longer than three years, deterioration has been noted (van Dijk et al 2006, van Dijk et al 2010). There is little research on predictors of functional decline. A longitudinal cohort study of 123 people with hip osteoarthritis found that several factors predicted 3-year worsening of function including range of motion, pain severity, cognitive impairment and co-morbidities (van Dijk et al 2010). Therefore, while progression of hip osteoarthritis can occur, it is not necessarily inevitable and for many people osteoarthritis may remain stable or even improve.

**Box 1. American College of Rheumatology clinical criteria for the diagnosis of hip osteoarthritis (Altman et al 1991).** Either set of criteria can be used. The sensitivity and specificity of these clinical criteria are 86% and 75% with a positive likelihood ratio of 3.44 and a negative likelihood ratio of 0.19.

<table>
<thead>
<tr>
<th>Clinical Set A</th>
<th>Clinical Set B</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Age &gt; 50 years</td>
<td>• Age &gt; 50 years</td>
</tr>
<tr>
<td>• Hip pain</td>
<td>• Hip pain</td>
</tr>
<tr>
<td>• Hip internal rotation ≥ 15 deg</td>
<td>• Hip internal rotation &lt; 15 deg</td>
</tr>
<tr>
<td>• Pain with hip internal rotation</td>
<td>• Hip flexion ≤ 115 deg</td>
</tr>
<tr>
<td>• Morning stiffness of the hip ≤ 60 min</td>
<td></td>
</tr>
</tbody>
</table>

**Diagnosis**

Hip osteoarthritis can generally be diagnosed by a combination of history and physical examination findings without the need for an X-ray and exposing the patient to unnecessary radiation. The most commonly used clinical criteria for diagnosing hip osteoarthritis are those from the American College of Rheumatology (Altman et al 1991), which include either of two sets of clinical features (Box 1).

Moderate-to-severe hip osteoarthritis can be confirmed on radiographs with findings including joint space narrowing, marginal osteophytes, subchondral sclerosis, and bone cysts. Magnetic resonance imaging is more useful than radiographs in detecting early structural changes such as focal cartilage defects and bone marrow lesions in the subchondral bone. Hip osteoarthritis has different radiological presentations based on the pattern of migration of the femoral head within the acetabulum. Superolateral femoral migration is more common in men while women have more superomedial migration (Ledingham et al 1992).

There is strong evidence that greater hip osteoarthritis disease progression is associated with certain structural features on radiographs including joint space narrowing, femoral osteophytes, bony sclerosis, and superolateral femoral migration (Wright et al 2009).

**Assessment**

In a subjective assessment, pain is a consistent finding, usually related to a particular movement or sustained position. Stiffness following rest can often be more problematic than pain (Sims 1999). An important part of the subjective assessment is to gain an understanding of the impact of psychosocial factors including mood disorders (eg, depression and anxiety) and sleep, social support, ability to cope, social wellbeing and participation in leisure, relationships, community, and employment. Exploring patient knowledge, expectations, and goals facilitates a patient-centred approach to communication and management.

A key part of the physical examination is to identify what adverse mechanical conditions the hip is being subjected to and what local and global factors are causing the
adverse conditions (Sims 1999). Reductions in all hip ranges of motion (Arokoski et al 2004) and weakness of the hip and thigh muscles, especially the hip abductor and quadriceps muscles, have been reported in people with hip osteoarthritis (Loureiro et al 2013). The weakness appears to be due primarily to a reduction in muscle size (atrophy) rather than inhibition (Loureiro et al 2013). Biomechanical studies have detected altered gait patterns that may be compensatory in nature to reduce loading on the painful hip or as a consequence of other impairments (Etizen et al 2012). In addition, balance impairments and reduced lower limb proprioception, which are linked to higher rates of falling, have been demonstrated among people with lower limb arthritis (Sturniels et al 2004).

Therapists should use validated outcome measures including self-report measures of pain (such as a visual analogue scale or numeric rating scale), physical function, and patient global rating of change, as well as physical performance measures. Clinical practice guidelines from the American Physical Therapy Association, specifically for hip osteoarthritis, recommend functional outcome measures, such as the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index, the Lower Extremity Functional Scale, and the Harris Hip Score, based on strong evidence (Cibulka et al 2009). The Osteoarthritis Research Society International (OARSI) has recently recommended a core set of physical performance measures for hip and knee osteoarthritis (Dobson et al 2013). The set comprises the 30-second chair stand test, a 40 m fast-paced walk test, and a stair climb test with additional tests including the Timed Up and Go test and the 6-minute Walk test.

**Principles of management of hip osteoarthritis**

Clinical guidelines advocate a combination of conservative non-drug and drug therapies for optimal hip osteoarthritis management (Zhang et al 2005). However, the vast majority of treatments currently available for osteoarthritis are drugs and/or surgery, and the current body of knowledge reflects this bias. A review of studies of hip osteoarthritis treatment showed that 74% assessed surgical procedures, 19% evaluated drug therapies, with only 7% evaluating conservative non-drug interventions (Zhang et al 2005). Whilst drugs may relieve symptoms, effect sizes are small to modest at best and their toxicity/adverse event profile is unfavourable compared to conservative non-drug interventions (Zhang et al 2007). Indeed, all clinical guidelines advocate conservative non-drug strategies for hip osteoarthritis (Conaghan et al 2008, Hochberg et al 2012, Zhang et al 2008). In particular, guidelines recommend a focus ‘on self-help and patient-driven treatments rather than on passive therapies delivered by health professionals’ (Zhang et al 2008). Treatment should be individualised and patient-centered, involving shared decision making between the patient and physiotherapist taking into account the patient’s preferences and wishes. Two recent systematic reviews have found that such patient-centred interaction enhances the therapeutic alliance (Pinto et al 2012a) and improves patient satisfaction with care (Oliveira et al 2012). Other aspects to consider in guiding treatment include: hip factors (adverse mechanical factors, impairments, obesity, physical activity, dysplasia); general factors (age, sex, co-morbidity); level of pain intensity and disability; and location and degree of structural damage (Zhang et al 2005).

Given the broad impact of osteoarthritis and in accordance with a biopsychosocial approach to the management of chronic pain, it is logical that both biological and psychosocial factors should be addressed in people with hip osteoarthritis. For hip osteoarthritis, core conservative treatments for all patients should include education and exercise. In addition, weight loss is also recommended for those with lower limb osteoarthritis who are overweight/obese (Conaghan et al 2008, Hochberg et al 2012, Zhang et al 2005, Zhang et al 2008). It is apparent that the treatments of exercise and weight loss for osteoarthritis require behavioural changes and it is well known that these changes are difficult to initiate and maintain. Therapists therefore need to assist the patient in formulating achievable short- and long-term goals and specific action plans.

**Education**

Patient education is a core component of hip osteoarthritis treatment as it is an indispensable element in promoting adequate self-management. Education delivery modes vary and can include informal discussion with the health care provider, provision of written materials, support groups, websites, and structured self-management programs. Self-management programs can also take various forms with differences in the content, mode of delivery (individual, group-based, telephone, internet), program length, and expertise of those delivering the material (lay leaders, health care professionals). Self-management programs typically include coping with behavioral change, educational information, and self-management techniques. Topics should cover: knowledge and understanding of osteoarthritis; the consequences of osteoarthritis on function, activities, and participation; the pain experience; the role of psychological factors; ways to deal with complaints caused by osteoarthritis; the importance of an active and healthy lifestyle including exercise, weight loss and sleep; joint protection strategies; communicating with health providers; and stress management and relaxation.

In general, however, the reported effects of isolated self-management programs for osteoarthritis have often been small or non-significant. A meta-analysis published in 2003 involving 17 trials of all types of arthritis found an effect size of only 0.12 for pain and 0.07 for disability (Warsi et al 2003). A more recent systematic review found five studies specifically involving people with hip or knee osteoarthritis (Iversen et al 2010). The programs and outcome measures were variable and the results generally showed no or modest benefits. A large randomised trial in the UK primary care setting involving 812 participants with hip or knee osteoarthritis found no difference in pain or function, but reduced anxiety and improved self efficacy to manage symptoms, between a 6-session self-management course including an educational booklet compared to administration of the educational booklet alone (Buszewicz et al 2006). In another study, a telephone-based self-management program delivered via 12 monthly telephone calls to people with hip or knee osteoarthritis produced moderate improvements in pain compared to a health education control group (Allen et al 2010). A 24-month randomised trial in people awaiting total hip joint replacement found that a group who received a multidisciplinary information session 2 to 6 weeks before...
<table>
<thead>
<tr>
<th>Reference</th>
<th>Population</th>
<th>Groups</th>
<th>Follow-up</th>
<th>Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Baar (1998)</td>
<td>Hip OA (n = 71) Knee OA (n = 119) Both (n = 10)</td>
<td>1) 12 weeks, 1–3×/week, 30 min session – muscle strength, mobility, movement, locomotion, and co-ordination 2) Usual care by general practitioner</td>
<td>Baseline 12 weeks</td>
<td>• VAS pain • Observed disability • Medication use</td>
<td>Exercise therapy associated with reduced pain and disability. Effect sizes were medium (0.58) and small (0.28), respectively</td>
</tr>
<tr>
<td>Hopman-Rock (2000)</td>
<td>Hip OA and knee OA (n = 120 in total)</td>
<td>1) 6 weeks of home-based 1×/wk, 60 min session – strengthening exercises for hip/knee (+ health education program) 2) No treatment</td>
<td>Baseline 6 weeks 6 months</td>
<td>• Pain • Quality of life • Muscle strength • Range of motion • Activity restrictions • Body mass index • Knowledge of OA and self efficacy • Health care usage</td>
<td>Benefits found for pain, quality of life, quadriceps strength, knowledge, self-efficacy, BMI, physically active lifestyle, and visits to physical therapist. Most effects moderate at post-test assessment and smaller at follow-up. No effects found for range of motion and functional tasks</td>
</tr>
<tr>
<td>Foley (2003)</td>
<td>Hip OA and knee OA (n = 105 in total)</td>
<td>1) 6 weeks of 3×/wk, 30 min session – gym program of strengthening exercises 2) 6 weeks of 3×/wk, 30 min session – aquatic exercises 3) Fortnightly telephone calls</td>
<td>Baseline 6 weeks</td>
<td>• WOMAC • Quadriceps strength • 6-minute walk test • Adelaide Activities Profile • SF-12 • Arthritis Self Efficacy • Drug use</td>
<td>In combined hip and knee OA group, gym program improved quads strength, walking speed and self efficacy compared to control. Aquatic exercise group was significantly different from controls in 6-min walk test, physical component of the SF-12 and left quadriceps strength only. No program improved pain</td>
</tr>
<tr>
<td>Ravaud (2004)</td>
<td>Hip OA (n = 741) Knee OA (n = 2216)</td>
<td>1) 12–24 weeks of at least 4×/wk, 30 min sessions – unsupervised home-based exercise program to improve muscle strength and range of motion 2) Usual medical care</td>
<td>Baseline 24 weeks</td>
<td>• VAS pain • WOMAC physical function • Global rating of status</td>
<td>Home exercise did not lead to significantly greater benefits than usual care after 6 months in pain or function in patients with hip OA receiving concomitant nonsteroidal anti-inflammatory drugs</td>
</tr>
<tr>
<td>Tak (2005)</td>
<td>Hip OA (n = 109)</td>
<td>1) 8 weeks of 1×/wk, 60 min session – strengthening exercises, treadmill 2) Usual care</td>
<td>Baseline 8 weeks 12 weeks</td>
<td>• VAS pain • Harris Hip Score • Sickness Impact Profile • Groningen Activity Restriction Scale • Timed functional tests • Quality of life</td>
<td>Exercise had positive effect on pain (moderate effect at post-test and small effect at follow-up), hip function (small effect at post-test), self-reported disability (small effect at follow-up), and timed Up &amp; Go test (small effect at follow-up)</td>
</tr>
<tr>
<td>Cochrane (2005)</td>
<td>Hip OA (n = 54) Knee OA (n = 258)</td>
<td>1) 52 weeks of 2×/wk, 60 min session – aquatic exercise 2) Usual care</td>
<td>Baseline 52 weeks 18 months</td>
<td>• WOMAC • SF-36 • EuroQol • Muscle strength • 8-foot walk • Stair ascent/descent • Heath care usage</td>
<td>In the combined hip/knee OA group, there were small significant benefits of aquatic exercise on pain and physical function at one year but these were not significant at 18 months. There was a favourable cost-benefit outcome</td>
</tr>
</tbody>
</table>
### Table 1. Summary of randomised controlled trials evaluating land-based and aquatic exercise for the management of hip osteoarthritis – continued

<table>
<thead>
<tr>
<th>Reference</th>
<th>Population</th>
<th>Groups</th>
<th>Follow-up</th>
<th>Outcomes</th>
<th>Results</th>
</tr>
</thead>
</table>
| Rooks (2006) | Hip OA (n = 63) Knee OA (n = 45) | 1) 6 weeks of 3×/wk, 30–60 min session – aquatic, strengthening and flexibility exercise  
2) Control – education via 2 mail outs and 3 telephone calls | Baseline 6 weeks  
8 weeks post op  
26 weeks post op | • WOMAC  
• SF-36  
• 1 rep max leg press  
• Functional reach test  
• Timed Up and Go | For the hip OA group, exercise significantly improved WOMAC physical function, SF-36 scores and muscle strength compared with controls pre-operatively but were not different post-operatively |
| Hinman (2007) | Hip OA (n = 16) Knee OA (n = 55) | 1) 6 weeks of 2×/wk, 45–60 min session – aquatic exercise  
2) Control – no aquatic exercise | Baseline 6 weeks  
12 weeks | • VAS movement pain  
• WOMAC  
• AQoL  
• Physical activity  
• Muscle strength  
• Timed Up and Go  
• 6-minute walk test  
• Step test  
• Patient global rating | In the combined hip/knee OA group, aquatic exercise resulted in significantly reduced pain and stiffness and improved physical function, hip muscle strength and quality of life with benefits sustained at 12 weeks in the combined hip and knee OA group. However, the effect sizes were small |
| Fransen (2007) | Hip OA (n = 20) Knee OA (n = 77) | 1) 12 weeks of 2×/wk (24×1 hour sessions) – class-based Sun style Tai Chi  
2) 12 weeks of 2×/wk (24×1 hour sessions) – class-based aquatic exercise  
3) Wait list control | Baseline 12 weeks  
24 weeks | • WOMAC  
• SF-12  
• DASS21  
• Patient global rating  
• Timed Up and Go  
• Stair climb test  
• 50-foot walk test | In the combined hip/knee OA group, both Tai Chi and aquatic exercise resulted in significant improvements in function with moderate effect sizes (0.63 and 0.62) compared with control. Aquatic exercise resulted in significant improvement in pain. Benefits were generally sustained at follow-up. Aquatic exercise improved in most other measures while Tai Chi only improved in stair climb test |
| Fernandes (2010) | Hip OA (n = 109) | 1) 12 weeks of 2×/wk supervised sessions plus access to gym – strengthening, functional and flexibility exercises. Also patient education  
2) Patient education – 3 group sessions and one individual physiotherapy visit | Baseline 16 weeks  
40 weeks  
16 months | • WOMAC  
• SF-36  
• Physical activity | No difference was found for pain at any time point. WOMAC physical function improved significantly at 40 weeks and 64 weeks compared to control |
| Juhakoski (2011) | Hip OA (n = 120) | 1) 12 weeks of 1×/wk, 45 min physiotherapist supervised group session and 4 additional booster sessions one year later as well as home exercises 3×/wk for 2 years – strengthening and stretching exercises plus usual care  
2) Usual care by general practitioner | Baseline 12 weeks  
24 weeks  
52 weeks  
18 months  
24 months | • WOMAC  
• SF-36  
• Range of motion  
• Extensor power  
• 6-minute walk test  
• 10-meter walk  
• Timed Up and Go  
• Sock test  
• Body mass index  
• Direct healthcare costs | No significant effect of exercise on WOMAC pain at any time point. Significant improvement in WOMAC physical function at 6 and 18 months although size of effect may not be clinically meaningful. No difference in performance-based measures nor in total health care system costs between groups |
Exercise group had significant improvements in WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) but not in other outcomes. No significant difference in primary outcome total WOMAC between exercise and control group in intention-to-treat analyses. Exercise led to significant improvements in physical performance measures compared to control.

Exercise is an integral component of conservative non-pharmacological management of osteoarthritis and is advised by clinical guidelines for all patients, irrespective of disease severity, age, co-morbidity, pain severity, or disability (Conaghan et al 2008, Hochberg et al 2012, Zhang et al 2008). Among the limited randomised trials, however, few have exclusively recruited people with hip osteoarthritis. The details of the relevant trials are presented in Table 1. The studies vary particularly with regard to the type, dosage, mode of delivery, and duration of the exercise program. Most include strengthening exercises alone or in combination with other types of exercise such as those targeting range of motion or balance. One study investigated Tai Chi and five investigated aquatic exercise. Although effective in people with knee osteoarthritis, aerobic land-based exercise such as walking has not been investigated in people with hip osteoarthritis. In most studies the participants exercised under the supervision of a physiotherapist. The duration of the interventions ranged from 6 to 12 weeks, except in two studies where it was 24 and 52 weeks.

Results of the studies to date suggest that treatment effects of exercise are generally small, as presented in Figure 2. A 2009 Cochrane review of land-based exercise for hip osteoarthritis, combining the results of five clinical trials, demonstrated a small treatment effect for pain but no benefit in terms of improved self-reported physical function (Fransen et al 2009). The authors concluded that the limited number and small sample sizes of the trials restricts the confidence that can be attributed to these results and that further clinical trials with larger sample sizes and exercise programs specifically designed for people with symptomatic hip osteoarthritis need to be conducted. Similar conclusions were reached by the authors of another 2009 systematic review where it was stated that there was insufficient evidence to suggest that exercise therapy alone can be an effective short-term management approach with respect to pain, function, and quality of life (McNair et al 2009). Conversely, the results of a 2008 meta-analysis were more favourable in terms of the benefits of exercise for pain relief in hip osteoarthritis but studies using aquatic programs were also included in the analysis as well as specific hip data obtained from the authors of the studies (Hernandez-Molina et al 2008). The review concluded that therapeutic exercise, especially with specialised hands-on exercise training and an element of strengthening, is an efficacious treatment for hip osteoarthritis.

Since these systematic reviews, four additional high-quality, large, randomised trials of exercise have provided data specific to hip osteoarthritis (Abbott et al 2013, Fernandes et al 2010, French et al 2013, Juhakoski et al 2011), as presented in Table 1. In general these trials found non-significant mean improvements in pain with various types of exercise that are well short of the benchmark minimum clinically important difference. When combined surgery had less preoperative anxiety and pain compared to those receiving usual information in an information leaflet (Giraudet-Le Quintrec et al 2003). Nevertheless, the relatively small effect sizes of self-management programs and patient education in isolation highlight that these should form one component of an overall treatment plan.
with the earlier studies in a meta-analysis, an overall
treatment effect on pain was significant but small (SMD
–0.30, 95% CI –0.51 to –0.09) as presented in Figure 2a. In
contrast to pain, exercise appeared to have greater effects
on physical function in the recent studies. With all studies
combined, the overall treatment effect on function was
again significant but small (SMD –0.23, 95% CI –0.45 to
–0.002) as presented in Figure 2b. In the study by Abbott
et al (2013), a multimodal exercise program with initial
physiotherapist-supervised sessions and home exercises
thrice weekly led to statistically and clinically significant
improvements in physical function at 2 years (p = 0.005),
but with suboptimal, non-significant effects on pain. Indeed
the effect size for physical function was double that of pain
(0.67 vs 0.33) (Abbott personal communication). Therefore,
evidence to date suggests that exercise has only modest
benefits that, in more recent studies, appear greater for
function than pain.

Aquatic exercise has been recommended as an exercise
option for people with hip osteoarthritis by the American
College of Rheumatology with the choice of land- or water-
based exercise dependent on patient preference and ability
to perform the exercises (Hochberg et al 2012). While
there are several randomised trials of aquatic exercise, it is
difficult to draw conclusions from these given their mixed
hip and knee osteoarthritis samples.

In addition to structured exercise, there is some evidence that
behavioural graded activity, an operant treatment approach,
may be effective in improving physical activity levels and
reducing need for joint replacement in people with hip
osteoarthritis. The operant principles include reinforcement
of healthy behaviors and withdrawal of attention to pain
behaviors to increase the time of performance of daily
activities. This approach has been evaluated in a Dutch
cluster-randomised trial (Veenhof et al 2006). In this
study, 200 people with hip and knee osteoarthritis were

A Pain

<table>
<thead>
<tr>
<th>Study</th>
<th>Standardised difference in means (95% CI)</th>
<th>Weight %</th>
<th>Standardised difference in means (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Barr 1998</td>
<td>–1.04 (–1.55 to –0.53)</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Hopman-Rock 2000</td>
<td>0.14 (–0.67 to 0.94)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Foley 2003</td>
<td>–0.56 (–1.56 to 0.43)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Tak 2005</td>
<td>–0.07 (–0.52 to 0.39)</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Fransen 2007a</td>
<td>0.03 (–0.98 to 1.04)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Fernandes 2010</td>
<td>–0.19 (–0.57 to 0.18)</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Juhakoski 2011</td>
<td>–0.26 (–0.62 to 0.10)</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>French 2013</td>
<td>–0.30 (–0.69 to 0.08)</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Abbott 2013a</td>
<td>−0.21 (–0.91 to 0.49)</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Pooled</td>
<td>–0.30 (–0.51 to –0.09)</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

B Physical Function

<table>
<thead>
<tr>
<th>Study</th>
<th>Standardised difference in means (95% CI)</th>
<th>Weight %</th>
<th>Standardised difference in means (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Barr 1998</td>
<td>0.36 (–0.12 to 0.84)</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Hopman-Rock 2000</td>
<td>–0.25 (–1.09 to 0.59)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Foley 2003</td>
<td>0.06 (–0.67 to 0.79)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Tak 2005</td>
<td>–0.18 (–0.74 to 0.39)</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Fransen 2007a</td>
<td>–1.21 (–2.29 to –0.13)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Fernandes 2010</td>
<td>–0.13 (–0.51 to 0.24)</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Juhakoski 2011</td>
<td>–0.41 (–0.77 to –0.04)</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>French 2013</td>
<td>–0.49 (–0.91 to –0.07)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Abbott 2013a</td>
<td>–0.35 (–1.05 to 0.36)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Pooled</td>
<td>–0.23 (–0.45 to –0.00)</td>
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randomised into a behavioural graded activity program or usual exercise therapy, delivered by physiotherapists. Both treatments consisted of a maximum of 18 sessions over 12 weeks while the behavioural graded activity program also involved 5 to 7 booster periods. The results showed similar benefits for pain and functional status from both treatments at 23, 39, and 65 weeks as well as at 5 years (Pisters et al 2010b). However, in participants with hip osteoarthritis, significantly fewer hip replacement surgeries were performed in the behavioural graded activity group compared with the usual exercise therapy group. A further benefit of the behavioural graded activity program was that participants had significantly better exercise adherence and higher physical activity levels than those in the usual exercise therapy group (Pisters et al 2010a). Given this and the fact that it was no more costly than usual exercise therapy (Coupe et al 2007), behavioural graded activity may be a useful treatment for people with osteoarthritis, particularly those with a relatively low level of physical function in whom greater benefits were found (Veenhof et al 2007).

Adherence is a key factor influencing the longer-term effectiveness of exercise in people with osteoarthritis. Although adherence to exercise is often good when commencing a program, it typically declines over time. A complex array of factors can influence adherence to exercise programs in people with osteoarthritis including intrinsic factors such as personal experience and individual attributes and extrinsic factors such as the physical and social environment (Petursdottir et al 2010), as presented in Figure 3. Numerous strategies have been suggested to improve adherence to exercise in people with osteoarthritis including individualising and supervising the program, educating patients about the disease process and the benefits of exercise, regular monitoring and booster sessions, and use of behavioural principles (eg, goal setting, reinforcing appropriate behaviours, feedback, rewards, use of written contracts, and motivational interviewing). However, a relatively recent systematic review found few clinical trials investigating the effectiveness of adherence strategies in people with chronic musculoskeletal pain including osteoarthritis (Jordan et al 2010).

Manual therapy

Manual therapy is commonly used in clinical practice for hip osteoarthritis with surveys revealing that 96% of Irish physiotherapists (French 2007) and over 80% of Australian physiotherapists (Cowan et al 2010) include it in their usual management of this patient group. While UK clinical osteoarthritis guidelines (Conaghan et al 2008) and those from the American Physical Therapy Association (Cibulka et al 2009) recommended manual therapy as an adjunctive treatment for hip osteoarthritis, to date only three randomised trials have evaluated the efficacy of manual therapy for this patient group (Abbott et al 2013, French et al 2013, Hoeksma et al 2004), with two providing high quality evidence of beneficial effects (Abbott et al 2013, Hoeksma et al 2004).

One study involving 109 participants with hip osteoarthritis compared a 5-week manual therapy program with a

Figure 3. Factors influencing exercise adherence for people with osteoarthritis.
therapist-supervised exercise program (Hoeksma et al 2004). The manual therapy comprised traction and high velocity thrust traction manipulation of the hip joint as well as muscle stretches of iliopectos, quadriceps, tensor fascia latae, gracilis, sartorius, and the hip adductors. The exercise program aimed to improve hip range of motion, muscle length, muscle strength, and walking endurance. While both groups improved following treatment, the success rate (defined as ‘improved’, ‘much improved’ or ‘free of complaints’) in the manual therapy group (81%) was significantly better than that in the exercise group (50%), (OR = 1.92, 95% CI 1.30 to 2.60). These benefits in favour of manual therapy were maintained at a 29-week follow-up.

A more recent factorial study comparing the effects of manual therapy and exercise, alone or combined, against usual care in 206 people with hip or knee osteoarthritis also confirmed the benefits of manual therapy (Abbott et al 2013). The manual therapy was delivered in 9 sessions (7 visits in the first 9 weeks with 2 booster sessions at Week 16) and consisted of techniques to modify the quality and range of motion together with a home program of up to six joint range-of-motion exercises. Overall, and among the participants with hip osteoarthritis only, manual therapy alone resulted in greater reductions in pain and disability immediately after the treatment (effect size = 0.74) that were maintained at 1-year follow-up (Figure 4). However, the combination of exercise with manual therapy did not confer additional benefits (effect size = 0.36) and in fact, the combination was generally less effective or at best no more effective than either treatment alone. These results are supported by those of another recent study that found no additive benefit of combining manual therapy (involving 6 to 8 sessions over an 8-week period with up to 5 non-manipulative lower grade mobilisation techniques per session) with exercise, except for patients’ satisfaction with their clinical outcome (French et al 2013). It has been postulated that those in the combined therapy group might spend less time on each intervention than do those who receive only one intervention, which subsequently decreases the effectiveness of both modalities (Abbott et al 2013).

While manual therapy appears to be beneficial, there may be specific subgroups of people with hip osteoarthritis who respond best to the intervention. Post hoc evaluation of the Hoeksma (2004) trial showed that the response to manual therapy was not influenced by baseline levels of hip function, pain, and range of motion. However, participants with mild or moderate hip osteoarthritis assessed radiographically had better range of motion outcomes with manual therapy than did those with severe osteoarthritis.

From a clinical perspective, a range of manual therapy techniques can be used to treat people with hip osteoarthritis. These include soft tissue techniques and stretches, mobilisation of accessory and physiological movements and manipulation. In addition, given the close link between the hip, lumbar spine, and sacroiliac joints, as well as the kinetic link with more peripheral joints, manual therapy to these other joints is often applied to people with hip osteoarthritis (Abbott et al 2013). However, a chiropractic study in people with mild to moderate hip osteoarthritis found no difference comparing a treatment regimen (9 treatments over a 5-week period) involving full kinetic chain manual and manipulative therapy plus exercise to that of one involving targeted hip manual and manipulative therapy plus exercise (Brantingham et al 2012). While there have been no reports of serious adverse events associated with the use of manual therapy in patients with hip osteoarthritis, therapists should advise patients about the possibility of self-limiting post-treatment soreness.

**Hip joint protection strategies**

While there are no clinical trials, interventions that reduce adverse mechanical forces across a compromised hip joint have face validity (Zhang et al 2005). The patient should be given appropriate joint protection advice guided by their aggravating factors and functional problems. The main advice is to avoid prolonged postures and activities that overload the joint.

**Gait aids.** During walking and stair ascent/descent, the hip joint is subjected to considerable loading with data from instrumented hip prostheses revealing hip loads of approximately 250% of body weight (Bergmann et al
Biomechanical studies demonstrate that use of a cane in the contralateral hand significantly reduces the load on the affected hip but increases load on the ipsilateral hip (Ajemian et al 2004). Thus therapists should be mindful of the effects of cane use on the ipsilateral side particularly if the patient has bilateral symptoms. A recent case series found that although initial use of a cane led to decreased gait velocity and cadence in people with hip osteoarthritis compared to walking unaided, these were restored after practice. However, there was no significant improvement in hip pain and function with four weeks of cane use, although inconsistent use may have contributed to this lack of benefit (Fang et al 2012). Patient education pointing out the value of a gait aid in improving function and reducing load at the hip joint may assist with adherence.

Weight loss. Being overweight or obese may be a risk factor for hip osteoarthritis (Jiang et al 2011). Greater body weight could have detrimental effects on joint structure by placing additional loads on the lower limb during walking and other daily activities as well as via general increases in substances that can directly degrade the joint or increase joint inflammation (Vincent et al 2012). Weight loss is recommended for those with lower limb osteoarthritis who are overweight or obese, generally defined as a body mass index > 25 kg/m² (Hochberg et al 2012, Zhang et al 2005). There are no randomised trials of weight loss interventions in people with hip osteoarthritis. However, a recent prospective cohort study found that an 8-month combined intervention of exercise and dietary weight loss resulted in a 33% improvement in self-reported physical function as well as reduced pain (Paans et al 2013). This provides preliminary evidence that exercise and weight loss combined are effective in people with hip osteoarthritis. While the amount of weight loss needed for clinical benefits is unknown, based on a limited number of trials in knee osteoarthritis, patients should reduce body weight by at least 5% using a combination of diet and exercise (Christensen et al 2007). The Ottawa Panel guidelines specifically recommend reducing weight prior to the implementation of weight-bearing exercise in order to maintain joint integrity and to avoid joint dysfunction (Brosseau et al 2011). Incorporating weight management interventions into the management of osteoarthritis is challenging as it requires considerable time and effort on behalf of both the patient and the health provider. Furthermore, to be effective, the health provider needs to be cognisant of behavioural change techniques. Given the complexity of weight loss, physiotherapists should work with an interdisciplinary team including dietitians who have expertise in this area.

Load carriage. Carrying loads increases the demands on the hip abductor muscles and consequently increases hip joint loading. Minimising the amount to be carried reduces load on the hip, as does carrying the item in the ipsilateral arm relative to the affected hip (Neumann 1999). Patients should be given specific advice for daily activities such as using a shopping trolley rather than carrying a basket.

Postural advice. People with hip osteoarthritis should be given advice about postures for sitting, sleeping and standing. Chairs should be firm and of appropriate height so that the patient sits without pain with the hip higher than the knee. Pillows, cushions or folded towels can be used to alter the chair height. Crossing the legs should be avoided. In the car, patients may sit on a folded towel to correct a backward sloping seat. For sleeping in side lying, a pillow may be used between the legs and limiting the amount of hip flexion can be helpful. In supine, a pillow can be placed under the knees. Prolonged standing should be avoided, as should standing in positions whereby weight is taken mostly on the affected side.

Footwear and heel raises. Clinical guidelines recommend that people with hip and knee osteoarthritis wear appropriate footwear (Zhang et al 2008). However, due to limited research, this recommendation is based solely on expert opinion and what constitutes ‘appropriate’ footwear has not been specifically defined for hip osteoarthritis. Intuitively, shoes with high heels should be discouraged given evidence of higher hip joint moments associated with walking in high heels (Simonsen et al 2012). Clinically, heel raises can be used to achieve pelvic obliquity and improve joint congruence in the setting of a functional leg-length discrepancy. When pelvic obliquity is improved with adduction of the hip, a heel raise can be applied on the affected leg while abduction of the hip can be achieved with a heel raise on the unaffected side. In an uncontrolled study, use of a heel raise (maximum of 1.5 cm in height) for an average of 23 months was associated with substantial decreases in pain in 33 people with hip osteoarthritis (Ohsawa and Ueno 1997). While there is no evidence from randomised trials supporting their use, heel raises are a simple inexpensive self-management option that can be trialled for their effects in individual patients.

Electrotherapy
The use of ultrasound, electromagnetic fields, and low-level laser therapy in clinical practice varies between countries. For example, surveys of physiotherapy practice found that Irish therapists reported frequent use of thermal agents and electrotherapy (French 2007), while Australian therapists reported infrequent use of these (Cowan et al 2010). Based on equivocal evidence or evidence of no benefit, electrotherapy is generally not recommended for the management of hip and knee osteoarthritis (Peter et al 2011). However, instructing patients in the use of thermal agents has been recommended by the recent American College of Rheumatology clinical guidelines as a self-management strategy (Hochberg et al 2012).

Future directions
Despite the relatively large amount of research into therapies for hip osteoarthritis compared to many other areas of physiotherapy, some questions remain unanswered and clinical guidelines still resort to expert opinion for some recommendations. Evidence is required to guide some key areas of physiotherapy management. The role of exercise in managing hip osteoarthritis should be clarified including comparisons of the effects of different exercise modalities (land-based, aquatic) and dosages. Manual therapy requires further investigation given the seemingly different results when it is delivered in isolation versus in combination with exercise. Randomised controlled trials are also needed to evaluate other interventions such as gait aids, heel wedges, and self-management programs. In parallel with this, investigation into the biomechanical, neuromuscular, and psychological mechanisms underpinning treatment effects will help to better understand outcomes and refine treatments.
In addition to assessing clinical effectiveness, economic evaluations should be included to establish the cost-effectiveness of treatments. This is important in today’s health care landscape to assist health policy makers in their decision-making regarding funding. A recent systematic review found few studies documenting cost-effectiveness for conservative non-drug interventions in hip or knee osteoarthritis (Pinto et al 2012b).

Given the heterogeneity in clinical presentation, it would also be useful to identify prognostic factors that predict which people with hip osteoarthritis are likely to demonstrate a favourable response to which physiotherapy intervention. In a recent study, five baseline variables were found to predict treatment responders to a physiotherapy program for hip osteoarthritis (Wright et al 2011) – unilateral hip pain, age ≤ 58 years, pain ≤ 6/10 on a numeric pain rating scale, 40 m self-paced walk test time of ≤ 26 sec, and duration of symptoms of ≤ 1 year. Having three or more of the five predictor variables increased the post-test probability of success to 99% or higher. While the results need to be validated in replication studies, they suggest that early referral for physiotherapy is preferable. Development of clinical prediction rules will assist clinicians in ascertaining the likelihood that their intervention will be effective for a particular patient.

There have been considerable advances at the knee in understanding the role of biomechanical factors in influencing knee osteoarthritis disease progression as well as investigating biomechanical interventions to reduce knee load such as footwear, bracing and gait retraining. This area could be extended to hip osteoarthritis to develop and evaluate potential disease-modifying treatments. In order to do this, better knowledge of the biomechanical and neuromuscular contributors to disease progression is also needed.

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