Chapter 1

General introduction
**Osteoarthritis**

Osteoarthritis (OA) is a relatively common musculoskeletal disorder, with a substantial impact on individuals and society. OA can occur in any joint but appears most frequently in the knee and hip joints. The prevalence of OA is strongly age-related, being less common before 40 years of age, but rising in frequency with age. Most people older than 70 years of age have radiological evidence of OA in some joints. However, not all people with pathologic and radiological evidence of OA have clinical symptoms.

The pathology of OA is characterised by focal areas of damage to the articular cartilage, centred on load-bearing areas, associated with new bone formation at the margins (osteophytosis), changes in the subchondral bone (sclerosis), variable degrees of mild synovitis, and thickening of the joint capsule. The clinical problems in patients with OA include joint pain, short-lasting inactivity stiffness of joints, cracking of joints (crepitus), capsular restrictions (reduced range of motion of joints), instability of joints, and muscle atrophy. These impairments in structures and/or functions have a major impact on patients’ physical functioning in daily life and frequently lead to moderate to severe limitations in participation and a decreased quality of life.

Recent research shows that pain and disability in patients with OA slowly deteriorates over time. However, there is considerable between-individual variation in the course of pain and activity limitations; some patients seem to be stable or even improve, whereas in other patients pain and disability deteriorates over time. Risk factors for functional decline are summarized in table 1.1.
Table 1.1: Risk factors for functional decline in osteoarthritis of the hip or knee

<table>
<thead>
<tr>
<th>Category</th>
<th>Risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairments</td>
<td>Pain, worsening of pain, stiffness and tender points. Reduced muscle strength, deterioration of muscle strength, laxity of the knee joint, proprioceptive inaccuracy and standing balance. Deterioration of range of joint motion</td>
</tr>
<tr>
<td>Co morbidity and overweight</td>
<td>Morbidity count and specific diagnoses</td>
</tr>
<tr>
<td>Psychological and social factors</td>
<td>Poor mental health, self-efficacy and social support; anxiety, depression, low vitality and fatigue</td>
</tr>
<tr>
<td>Health Behavior</td>
<td>Lack of vigorous physical activity</td>
</tr>
<tr>
<td>Socio demographic factors</td>
<td>Higher age, female sex, ethnicity, lower social class and being retired</td>
</tr>
</tbody>
</table>

Important modifiable risk factors for functional decline in patients with OA of the hip or knee are a reduced muscle strength, laxity of the knee joint, proprioceptive inaccuracy, standing balance, a reduced range of motion, overweight and a lack of vigorous physical activity. Recent research points out that instability of the knee (i.e. inability of the knee to maintain a position or to control movements under different external loads) affects limitations in activities as well \(^\text{11,12}\). However, the prognostic value of instability of the knee is unknown, because the impact of instability on limitations in activities has so far only been evaluated in cross-sectional studies.

The impact of psychological factors on functional decline can be interpreted in terms of avoidance of activity\(^\text{13,14}\). Patients with osteoarthritis tend to avoid activity, because activity induces pain.\(^\text{15}\) Negative affect (e.g. anxiety, depression and low vitality) and a more passive coping style are thought to strengthen the tendency to avoid activity \(^\text{13,16}\). However, a lack of physical activity induces muscle weakness, a reduced range of motion, instability of joints. Furthermore, a lack of regular physical activity almost doubled the odds of functional decline in patients with osteoarthritis \(^\text{8}\). Consequently, patients avoid activity even more and enter a vicious circle towards a higher level of pain and disability (see figure 1.1).
Figure 1.1: The avoidance Model

Pain experienced during activity

Fear of pain during activity

Avoidance of activity

Disability

Deterioration of physical condition (e.g. muscle strength, range of motion, instability of joints)

Management of hip or knee osteoarthritis

Both pharmacological (e.g. simple analgesic or nonsteroidal anti-inflammatory drugs) and non-pharmacological treatment modalities (patient education, therapeutic exercise, therapy appliances (stick, insoles) and weight reduction if obese or overweight) are recommended in guidelines for the management of osteoarthritis of the hip or knee.\textsuperscript{17-20} Drug therapy for pain management are most effective when combined with non-pharmacological strategies.\textsuperscript{17,18,21} In advanced disease (refractory pain and disability), partial or total replacement of joints is indicated.
Physical therapy

Based on the existing scientific evidence, the Dutch guideline for physical therapy in patients with OA recommends that the treatment should consist of exercises to reduce impairments in body functions due to OA (e.g. muscle strengthening exercises), prescription of home exercises, and to inform patients about the disease and to advise patients how to cope with their disease. Therapeutic exercise therapy in patients with OA of the hip and/or knee is mainly directed at reducing impairments in body functions (e.g. pain, muscle strength, stability of joints, range of motion, balance), which limit the performance of activities. Exercises can differ in content (e.g., muscle strengthening exercises, functional task-oriented exercises), dosage (e.g., frequency, intensity, duration), and delivery mode (e.g., individualized, group based, home based). The treatment is individually tailored, based on the physiotherapists hypothesis-oriented clinical decision-making process. The ultimate goal is to improve patients’ overall function, so that individuals can better meet the demands of daily living.

Effectiveness of exercise therapy

Several systematic reviews outline the effectiveness of exercise therapy in the OA population. These reviews conclude that there is strong evidence that exercise therapy has beneficial effects on pain, physical function and patients’ self perceived effect in patients with OA of hip and/or knee. However, most of the included studies in these systematic reviews focus on short-term results, ignoring long-term effects. Because OA of the hip and/or knee is a progressive disease and patients have to cope with their disease and its functional consequences for the rest of their lives, it is important that beneficial post-treatment results are sustained in the long term. The limited number of studies that investigated the long term effects of exercise therapy indicated that the positive post-treatment effects of exercise therapy seem to decline after discharge. However, since the publication of the reviews mentioned above, several new randomized clinical trials of exercise therapy in patients with OA have been published. Because some of these trials also focused on the long-term effectiveness of exercise therapy, a synthesis of the
current evidence on the long-term effectiveness of exercise therapy in patients with OA of the hip or knee is needed.

**Exercise adherence**

Several authors hypothesized that the success of exercise therapy largely depends on the patients’ level of adherence.\(^{32,33}\) Although it is well documented in the context of other chronic conditions, research on exercise adherence in the management of OA remains limited. In most existing studies in patients with OA, adherence was defined as attendance to treatment sessions and predominantly focused on adherence within the period of treatment. These studies demonstrated that consistent participation in exercise programs results in better outcomes.\(^{27,34-38}\) It can, however, be expected that the success of exercise therapy also depends on the extent to which a person’s behavior corresponds with agreed recommendations from the patient’s physical therapist, such as: doing home exercises (e.g. muscle strengthening exercises), and home activities (e.g. walking, or cycling, etc). This applies in particular to the effectiveness of exercise therapy in the long-term: it is hypothesized that it is important that patients continue to do their home exercises and activities after discharge and continue being more physically active. Therefore, a distinction must be made between exercise adherence within the period of treatment and exercise adherence after the treatment period (see figure 1.2).
Up till now only two well designed studies in patients with OA investigated the relation between the extent to which a person’s behavior corresponds with agreed recommendations from the patient’s physical therapist and the effectiveness of exercise therapy. These studies demonstrated that patients who were adherent to recommended home exercises within the period of treatment, reported more improvements post-treatment in pain and muscle strength.\textsuperscript{39,40} Research on the relationship between exercise adherence after the treatment period and the long-term effectiveness of exercise therapy is however lacking. Furthermore, it remains unclear if better exercise adherence is associated with better improvements in patients physical function and patients’ self perceived effect.

Given the expectation that the effectiveness of therapeutic exercise therapy depends on the degree of exercise adherence, insight in predictors of exercise adherence is important. Four domains of potential determinants might be important for predicting patients’ adherence, namely individual, psychological, intervention-related and illness-related factors (see figure 1.2).\textsuperscript{32} Research specifically focused on identifying predictors of adherence in physical therapy exercise interventions among patients with OA remains limited and is mainly focused on determinants of exercise adherence within
Within the period of treatment the physical therapist has more or less a direct perception, influence and control over the level of adherence to the recommended exercises and/or activities. After the treatment period (after discharge), the influence of the physical therapists is minimal or absent and adherence behavior must literally be self-regulatory in nature in order to be maintained. It is therefore hypothesized that predictors of adherence will differ for exercise adherence within the period of treatment and exercise adherence after the treatment period.

**Behavioral graded activity**

To improve the long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee, it is expected that exercise programs should become more functional and task-oriented, including additional booster sessions and strategies to improve exercise behavior and self-regulation skills. It is hypothesized that home exercises that simulate the conditions of daily tasks will enhance adherence after discharge and will finally lead to a more physically active lifestyle. Veenhof et al. recently developed and evaluated an exercise program based on these principles called the ‘behavioral graded activity’ (BGA) program. The BGA treatment is an individually tailored exercise program in which patients’ most problematic physical activities are gradually increased in a time contingent way. Furthermore, the intervention includes individually tailored exercises to improve impairments limiting the performance of these activities. The BGA program consists of a facility-based treatment period followed by additional booster sessions. This form of exercise therapy uses operant behavioral principles, self-regulation principles and booster sessions, in order to improve and maintain patients exercise behavior. The ultimate goal is integration of recommended exercises and activities into patients’ daily living, so that patients get a more physically active lifestyle. In additional booster sessions patients are supported and stimulated to sustain their physically active lifestyle and integrate exercises and activities into their daily life.
Chapter 1

Earlier research has shown that both BGA and usual exercise therapy treatment by physical therapists according the Dutch guideline (usual care; UC)\textsuperscript{22} results in positive effects on pain and physical functioning.\textsuperscript{43} Significant differences in effectiveness in favor of BGA were found in physical functioning, measured with the MACTAR-questionnaire and 5 meter walking test. It is expected that BGA will result in the long-term in better exercise adherence and a more physically active lifestyle and consequently in better long-term effectiveness than the usual exercise treatment according the Dutch Physical Therapy guideline.

\textbf{Aim and scope of the thesis}

The overall aim of this thesis was to investigate the long-term effectiveness of exercise therapy and the role of exercise adherence in patients with osteoarthritis of the hip or knee.

In a systematic review the long-term effectiveness (>6 months after treatment) of exercise therapy on pain, physical function, and patient global assessment of effectiveness in patients with osteoarthritis (OA) of the hip and/or knee was investigated (chapter 2). Furthermore, it was hypothesized that an exercise program integrating operant behavioral principles, self-regulation principles and additional booster sessions called ‘behavioral graded activity’ (BGA) results in less pain, less limitations in activities and better patient global assessment than treating patients according the Dutch guideline for physical therapy in patients with OA of the hip and/or knee. In a randomized controlled trial comparing both treatments the long-term effectiveness was investigated (chapter 3). Several authors have suggested that a lack of exercise adherence is the main reason for poor long-term effectiveness of exercise therapy in patients with OA. Therefore, the relationship between adherence and patients’ outcome on pain, physical function and patient self-perceived effect in patients with OA of the hip and/or knee was investigated (chapter 4). The aim of chapter 5 was to determine whether BGA results in better exercise adherence and a higher level of physical activity compared to usual exercise therapy treatment (UC) in patients with OA of hip or knee. And finally, the objective of chapter 6 was to explore determinants of adherence to recommended exercises and/or
activities within and after the period of treatment in therapeutic exercise therapy in patients with OA of the hip and/or knee.

An overall discussion of the findings in this thesis is provided in chapter 7. Chapter 2-6 were originally written as separate articles for publication in international peer reviewed scientific journals. Therefore, some overlap between chapters is inevitable, especially with regard to the description of the methodology.

In summary, the following research questions are being examined in this thesis:

- What is the long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee? (chapter 2)
- What is the long-term effectiveness of behavioral graded activity on pain, physical function and patients global assessment compared with exercise therapy following the Dutch guideline for physiotherapy? (chapter 3)
- What is the relationship between adherence and patients’ outcome on pain, physical function and patient self-perceived effect in exercise therapy treatment in patients with OA of the hip and/or knee? (chapter 4)
- Does behavioral graded activity result in better exercise adherence and a higher level of physical activity than usual exercise therapy treatment (UC) in patients with OA of hip or knee? (chapter 5)
- What are determinants of adherence to recommended exercises and/or activities within and after the period of treatment in therapeutic exercise therapy in patients with OA of the hip and/or knee? (chapter 6)
Chapter 1

References


(27) Ettinger WH, Jr., Burns R, Messier SP, Applegate W, Rejeski WJ, Morgan T et al. A randomized trial comparing aerobic exercise and resistance exercise with...


General introduction


