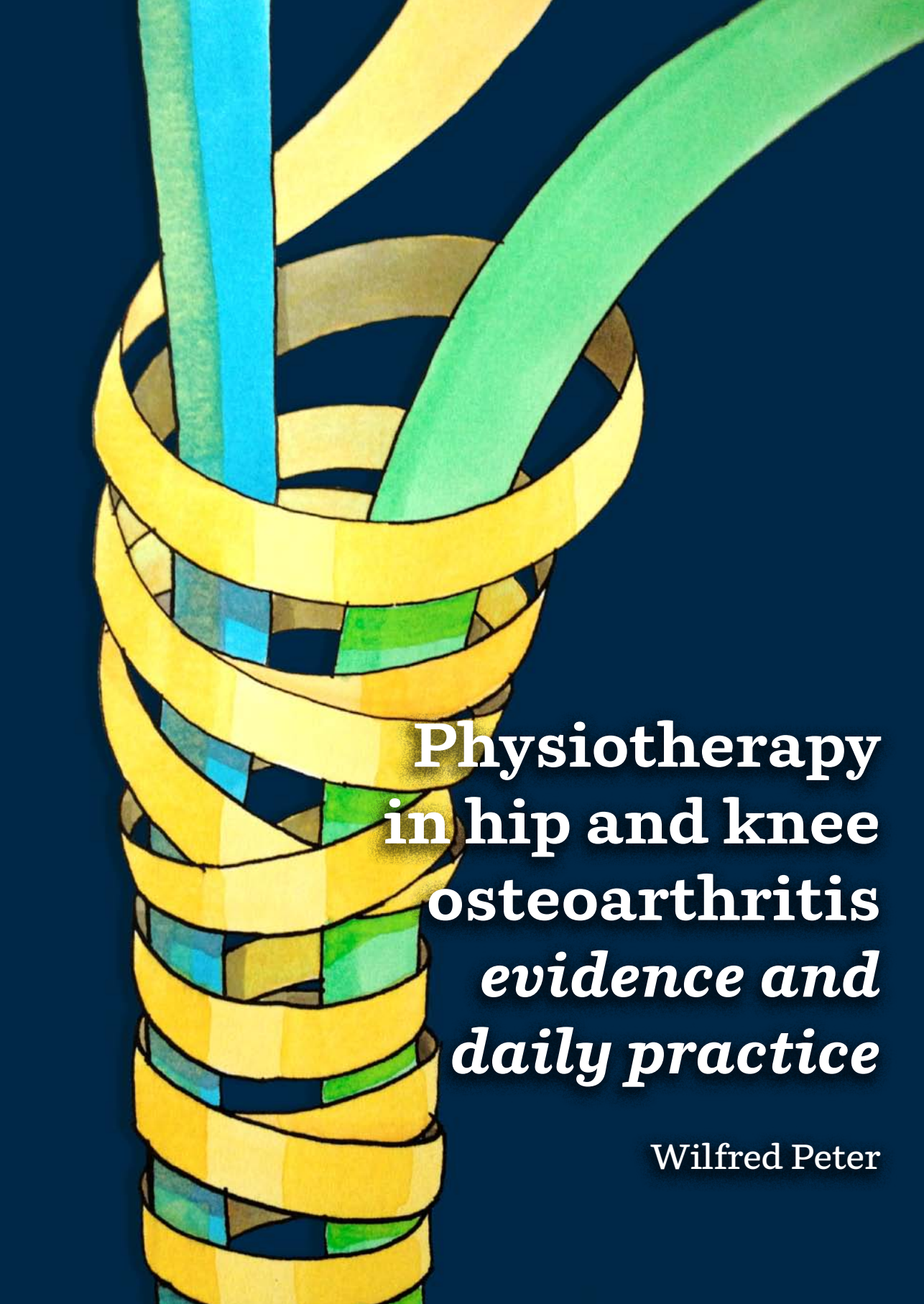

Physiotherapy in hip and knee osteoarthritis *evidence and daily practice*

Wilfred Peter

Physiotherapy in hip and knee osteoarthritis:
evidence and daily practice

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Universiteit Leiden
The Netherlands

Colophon

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To me, the image represents the bridging of the fields of research and daily clinical practice by means of implementation strategies in order to bring these fields more closely together to ensure an improvement in quality of care (WP).

Physiotherapy in hip and knee osteoarthritis: *evidence and daily practice*

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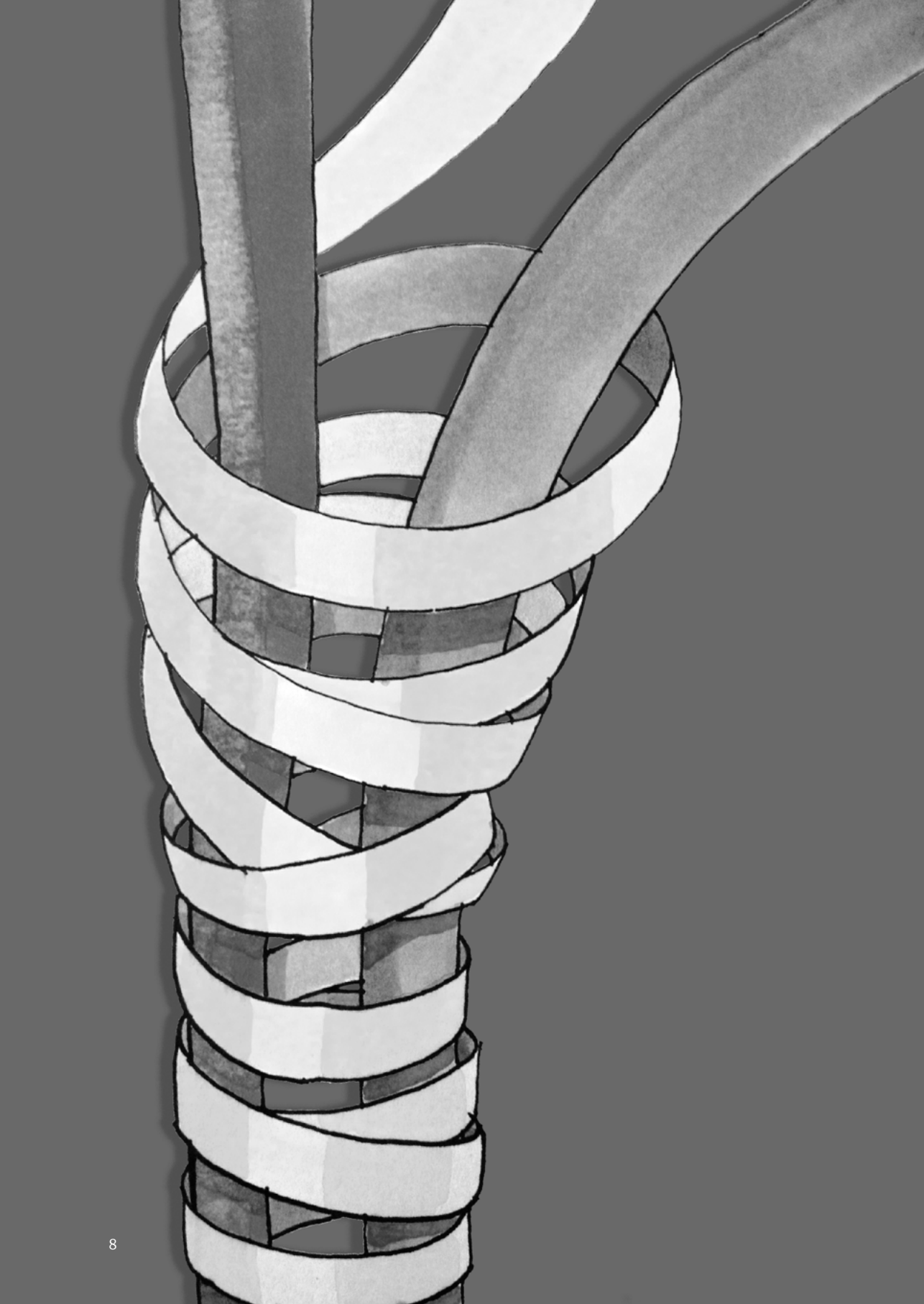

Chapter 1

General Introduction

Parts of this introduction have been published as:
Peter WFH, Jansen MJ, H. Bloo, Dekker-Bakker LMMCJ, Dilling RG, Hilberdink WKHA, Kersten-Smit C, Rooij de M, Veenhof C, Vermeulen HM, de Vos I, Schoones JW, Vliet Vlieland TPM,
Update of the Dutch physiotherapy guideline on hip and knee osteoarthritis,
Nederlands Tijdschrift voor Fysiotherapie 2010;120(1) Accessible at: http://www.fysionet-evidencebased.nl/index.php/kngf-guidelines-in-english) (Consulted at October 23 2014).

Osteoarthritis

Osteoarthritis is the most common form of arthritis, with hip and knee osteoarthritis being the most prevalent causes of global disability.[1,2] Osteoarthritis is characterised by a slowly and intermittently progressive loss of cartilage from joints. In addition, there may be changes to the subchondral bone and proliferation of the bone at the margins of the joint (osteophyte formation). The synovial membrane maybe periodically irritated, inducing inflammation of the joint.[3]

Epidemiology

The number of people suffering from osteoarthritis of the hip and/or knee in the Netherlands on January 1st, 2011 was estimated to be 359.000 men and 594.000 women, corresponding to a prevalence of 43.6 per 1000 men and 70.6 per 1000 women.[4] Osteoarthritis of the knee is more common than osteoarthritis of the hip. The annual numbers of new patients with osteoarthritis of the hip and/or knee in the Netherlands in 2011 were estimated to be 36.000 men and 54.000 women, corresponding to an annual incidence of 4.3 per 1000 men and 6.4 per 1000 women. [4] The risk of osteoarthritis increases with age, showing a peak around the age of 78 to 79 years, after which the risk decreases again. Each year, 4.3 percent of the people who present to their general practitioner with osteoarthritis of the hip and/or knee are referred to a physiotherapist. Many people suffering from osteoarthritis are not known as such to their general practitioner, and since the prevalence and incidence of osteoarthritis were estimated from primary care registration systems, the true number of persons with osteoarthritis of the hip and/or knee in the general population is probably 2 to 3.5 times higher than the number known to general practitioners.[5]

Based on demographic trends alone, the absolute number of people with osteoarthritis is expected to rise by almost 40 percent between 2011 and 2030. In view of the expected rise in the number of severely overweight people (with a Body Mass Index > 30), the actual future prevalence of osteoarthritis may be even higher.[5]

Diagnosis

Characteristic features of osteoarthritis of the hip and/or knee include pain, stiffness and eventually a decline in everyday functioning[6,7], which in many cases is influenced by lack of physical activity. In addition, patients may suffer from reduced joint mobility, reduced muscle strength, joint instability, and crepitation. There are often radiographic abnormalities, but these do not correlate closely to complaints like pain, stiffness, and lack of joint mobility. Sometimes there may be obvious osteoarthritis-related radiographic abnormalities, even though the patient experiences no pain or impaired movements. The risk of clinical symptoms does, however, increase with the level of radiographic abnormalities.[8] There are as yet no diagnostic criteria for osteoarthritis of the hip, although the European League Against Rheumatism (EULAR) has recently

established diagnostic criteria for osteoarthritis of the knee.[9] Figure 1 summarises the main factors relevant for the diagnosis of osteoarthritis of the knee.

The clinical diagnosis is established by a physician on the basis of history-taking and physical examination, sometimes supplemented by laboratory tests and/or conventional radiographic (X-ray) examination. Such additional examinations are not strictly necessary if a patient has the classic history and physical examination findings.
Laboratory tests of patients with osteoarthritis show normal values for erythrocyte sedimentation rate, unlike what is seen in rheumatoid arthritis. Radiographic examinations are often done at the patient's request, to confirm the diagnosis. Several grading systems for X-ray findings have been proposed, the most commonly used being that by

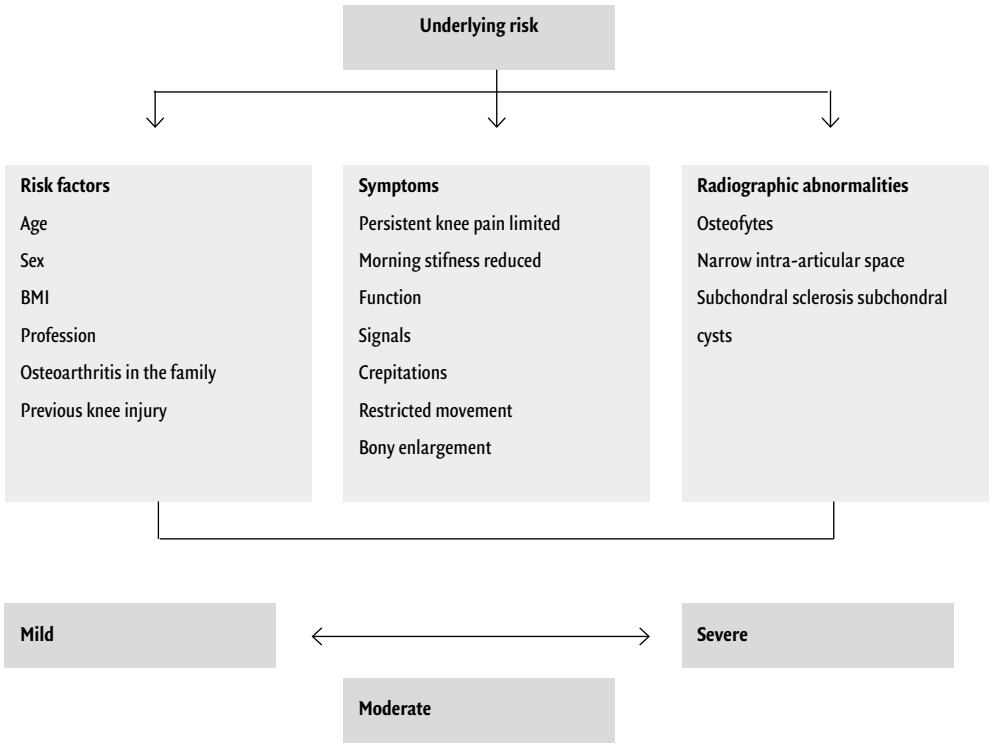

Figure 1. Zhang W, Doherty M, Peat G, Bierma-Zeinstra MA, Arden NK, Bresnihan B, Herrero-Beaumont G, Kirschner S, Leeb BF, Lohmander LS, Mazières B, Pavelka K, Punzi L, So AK, Tuncer T, Watt I, Bijlsma JW. EULAR evidence-based recommendations for the diagnosis of knee osteoarthritis. Ann Rheum Dis. 2010 Mar;69(3):483-9.

Kellgren and Lawrence, based on the degree of cartilage loss, the presence of osteophytes, the degree of sclerosis of the subchondral bone, and the formation of cysts.[10] The system distinguishes 5 grades (0-4), with grade 2 or higher indicating the presence of radiographic osteoarthritis. In these cases, a preliminary stage of osteoarthritis may have gone unnoticed for years.
Ultrasound examinations can play a role in differential diagnostics in some exceptional cases. Magnetic Resonance Imaging (MRI) is not normally indicated for osteoarthritis diagnosis, and is an expensive method. There is, however, a great deal of interest in MRI for research purposes, as MRI evidence of bone marrow oedema may predict increases in radiographic abnormalities.
Secondary care physicians may consider additional radiographic examinations to confirm the diagnosis, to optimise therapy, in cases where there is a discrepancy between physical examination findings and the patient's complaints, if a patient fails to respond sufficiently to therapy, or for research purposes. Routine practice usually uses the clinical diagnosis of osteoarthritis of the hip and/or knee. In view of the lack of correlation between the severity of complaints and functional limitations on the one hand and radiographic abnormalities on the other, there is no point in using additional radiographic examination in primary care to establish the diagnosis of osteoarthritis[11], although such additional radiographic examination can help optimise the clinical approach.

General clinical characteristics

For most patients, the most important symptom of osteoarthritis of the hip and/or knee is pain. In the early stages, this pain occurs when the patient starts to move or after prolonged weight bearing; the pain commonly increases as the day progresses. In later stages, the pain is also felt at rest and during the night. Stiffness associated with osteoarthritis is usually associated with starting a movement, and tends to disappear after a few minutes. Palpation may reveal bony enlargements (osteophytes) at the margins of the joint, which are tender. In addition to these osteophytes, there may be soft tissue swelling or intra-articular swelling (hydrops or synovitis). A characteristic feature of osteoarthritis is crepitation, which can be heard as well as felt, and are probably caused by the rough intra-articular surfaces and the bony enlargements rubbing against the ligaments.[12]

Pain in osteoarthritis of the hip is usually located in the groin and on the anterolateral side of the hip, or sometimes in the upper leg or radiating to the upper leg and knee. Apart from age (60 years), a number of clinical factors predict the presence and severity of radiographic signs of osteoarthritis and the severity of complaints. These factors are: pain persisting for more than three months, pain not increasing when the patient sits down, tenderness upon palpation across the inguinal ligament, limited exorotation,

Table 1a. Risk factors for the development of osteoarthritis of the hip and/or knee.

Systemic factors	Biomechanical factors	
	Intrinsic factors	*Extrinsic factors*
• age	• previous trauma	• overweight**
• ethnicity*	• joint disorders (e.g. septic arthritis, reactive arthritis or crystalline arthritis)	• strenuous profession (much lifting, squatting and kneeling)
• genetic predisposition*	• congenital factors (e.g. congenital hip dysplasia, Perthes disease and femoral epiphysiolysis)	• sports (esp. top level sports like soccer or ballet)
• sex	• surgery (e.g. menisectomy)	• prolonged squatting**
• overweight**	• muscular weakness**	
• generalized osteoarthritis	• laxity**	
• malalignment (knee)		

* less relevant in osteoarthritis of the knee.
** less relevant in osteoarthritis of the hip.

Table 1b. Risk factors for radiographic and clinical progression of osteoarthritis of the hip and/or knee.

Radiographic progression	Clinical progression
	• psychosocial factors
	• depression
• overweight	• low self-efficacy
• generalized osteoarthritis	• low socioeconomic status
• radiographic abnormalities (degree of joint destruction) at first diagnosis*	• lack of exercise
	• advanced age*
• atrophy of the bone*	• female sex*
• elevated CRP	• comorbidity (e.g. heart and lung disorders, type 2 diabetes mellitus, poor visual acuity, other articular disorders)
• elevated hyaluronic acid level in the joint	• pain
• malalignment (of the knee)	• muscular weakness
• genetic predisposition	• reduced proprioception
	• increased laxity of joint

* not relevant for osteoarthritis of the knee. CRP = C-reactive protein.

endorotation, and adduction, a bony sensation at the extremes of passive movement and loss of muscle strength in hip adduction.[13] Pain in osteoarthritis of the knee is usually located in and around the knee, though it may also be located in the upper leg or hip.

A number of clinical factors predict the presence and severity of radiographic signs of osteoarthritis: age over 50 years, morning stiffness lasting less than 30 minutes, crepitation upon movement assessment, tenderness of bony structures, bony enlargement of the knee joint and no raised temperature in the knee joint.[14] Occasionally, the synovium of the hip or knee joint may become inflamed, which may result in pain, swelling and raised temperature.[12] Another characteristic of osteoarthritis is restricted joint mobility, while increasing deterioration of articular structures may cause position deformities, such as genu varum or genu valgum. These changes can lead to instability. The stability of a joint can be defined as 'the capacity to maintain a particular position of the joint or to control movements affected by external strain.' The stability of a joint is ensured by the passive supportive apparatus (ligaments, capsule) and the active neuromuscular system (muscle strength, proprioception). Ensuring the stability of a joint must be regarded as a process affected by a number of factors (including muscle strength, proprioception and laxity).[15,16] The pain, stiffness, reduced joint mobility, deformities and/or stability problems in both knee and hip osteoarthritis may lead to problems with activities of daily living like walking, stair-walking, sitting down and getting up and putting on socks and shoes. Stability problems can cause a sense of insecurity during activities. Eventually, the abnormalities and limitations in activities of daily living can lead to restricted participation in society, in terms of e.g. work, recreation or sports.

Risk factors for development and progression

Osteoarthritis is considered to be a multifactorial disorder, and it is not yet clear which factors play a role in which patients. Factors influencing the development of osteoarthritis of the hip and/or knee are subdivided into systemic and biomechanical factors (Table 1a). Systemic factors determine the individual vulnerability of a joint to the effect of local biomechanical factors, resulting in osteoarthritis in a particular joint with a particular severity. Moreover, the risk of developing osteoarthritis increases with age and is more common among women than among men. Ethnicity and certain genetic factors have also been found to play a role in the development of osteoarthritis of the hip and/or knee. Local biomechanical factors can be subdivided into intrinsic local factors, which affect the load-bearing capacity of the joint, and extrinsic local factors, which influence the actual load borne by the joint. Not all risk factors are equally important in determining for different localizations of osteoarthritis: ethnicity and genetic predisposition appear to be more important in the development of osteoarthritis of the hip, while overweight and prolonged squatting increase the risk of osteoarthritis of the knee.[13,14,17-21]

Table 2. ICF Core Set for osteoarthritis, adapted for osteoarthritis of the hip and/or knee

Body functions
- Energy and drive (b130)
- Sleep (b134)
- Emotional (b152)
- Proprioception (b260)*
- Sensation of pain (b280)
- Mobility of joint (b710)
- Stability of joint (b715)
- Mobility of bone (b720)
- Muscle power (b730)
- Muscle tone (b735)
- Muscle endurance (b740)
- Control of voluntary movement (b760)
- Gait pattern (b770)
- Sensations related to muscles and movement (b780)

Body structures
- Structure of pelvic region (s740)
- Structure of lower extremity (s750)
- Additional musculoskeletal structures related to movement (s770)
- Structures related to movement, unspecified (s799)

Activities
- Changing basic body position (d410)
- Maintaining a body position (d415)
- Transferring oneself (d420)*
- Walking (d450)
- Moving around (d455)
- Using transportation (d470)
- Moving around using equipment (d465)*
- Driving (d475)
- Washing oneself (d510)
- Toileting (d530)
- Dressing (d540)
- Acquisition of goods and services (d620)
- Doing housework (d640)
- Assisting others (d660)
- Intimate relationships (d770)

Environmental factors
- Products or substances for personal consumption (e110)
- Products and technology for personal use in daily living (e115)
- Products and technology for personal indoor and outdoor mobility and transportation (e120)
- Products and technology for employment (e135)
- Products and technology for culture, recreation, and sport (e140)*
- Design, construction, and building products and technology of buildings for public use (e150)
- Design, construction, and building products and technology of buildings for private use (e155)
- Climate (e225)
- Immediate family (e310)
- Friends (e320)
- Personal care providers and personal assistants (e340)
- Health professionals (e355)
- Individual attitudes of immediate family members (e410)
- Individual attitudes of health professionals (e450)
- Societal attitudes (e460)
- Transportation services, systems, and policies (e540)
- General social support services, systems, and policies (e575)
- Health services, systems, and policies (e580)

Personal factors*
- Age
- Sex
- Ethnicity
- Social background
- Education
- Profession
- Past and present experiences
- Comorbidity
- Personality traits
- Skills
- Lifestyle
- Habits
- Upbringing
- Coping
- Self-efficacy
- Disease perception

Participation
- Remunerative employment (d850)
- Non-remunerative employment (d855)*
- Community life (d910)
- Recreation and leisure (d920)

* added by development team of the Dutch physiotherapy guideline for hip and knee osteoarthritis (Peter WF, Jansen MJ, Hurkmans EJ, Bloo H, Dekker-Bakker LM, Dilling RG, Hilberdink WK, Kersten-Smit C, de Rooij M, Veenhof C, Vermeulen HM, de Vos I, Schoones JW, Vliet Vlieland TP. Physiotherapy in hip and knee osteoarthritis: development of a practice guideline concerning initial assessment, treatment and evaluation. Acta Reumatol Port. 2011:36:268-281).

In addition to the risk factors for the development of osteoarthritis, there are also risk factors for its progression (Table 1b). These factors may be linked to radiographic progression or progression of clinical symptoms, and once again, not all factors are equally important for osteoarthritis of the hip and of the knee. Overweight is more important as a risk factor for progression of osteoarthritis of the knee than of the hip, whereas higher age, female sex and radiographic abnormalities at the time of diagnosis are major risk factors particularly for progression of osteoarthritis of the hip.[14,21-26]

Course of the disease

The natural course of the disease is highly heterogeneous. Generally speaking, osteoarthritis is a slowly progressive process, in which periods of relative stability, without severe symptoms, alternate with more active periods, in terms of more pain and/or signs of inflammation. There may also be 'flares', a sudden increase in disease activity, with inflammatory symptoms. The rate at which osteoarthritis progresses depends partly on the risk factors present.

In end-stages of hip and knee osteoarthritis, and if other (non)pharmacological treatment options are ineffective, total joint replacement surgery is a very effective treatment option.

Health related problems

The health problems faced by people suffering from osteoarthritis of the hip and/or knee are part of a wider spectrum of health problems in this group of patients, which can be described using the 'International Classification of Functioning (ICF) Core Sets for osteoarthritis' (Table 2).[27]

General treatment

No treatment is as yet known to cure osteoarthritis, and the main treatment components are currently lifestyle advice (including physical activity, joint protection measures, and losing weight), pharmacological pain control, exercise therapy and, if these options do not provide sufficient relief, surgery. Treatment in routine practice often involves several interventions simultaneously, such as a combination of pain medication, exercise therapy and patient education. Given the need for various interventions, different care providers may be involved in the management of patients with hip or knee osteoarthritis, such as the general practitioner, physiotherapist, nurse practitioner, occupational therapist, orthopaedic surgeon, rheumatologist, social worker, psychologist, or dietician. The involvement of the different care providers depends on many factors, such as the need and preferences of the patient, or the local availability of care.

Pharmacological treatment

The first step in pharmacological treatment exists of the use of paracetamol (aminocetaphen) in adequate dosage to decrease the pain level. Paracetamol is the first choice because of its safety, and can be prescribed in a dosage of 3 gram per day. I case of insufficient effect non-steroidal anti-inflammatory drugs (NSAIDs) are advised, according a 'on demand' schedule. A drawback in using NSAIDs is the risk for gastro-intestinal ulcera and their complications, but also the risk for cardiovascular side effects. In patients with side effects of NSAID a combination of NSAIDs with paracetamol or tramadol can be prescribed in order to decrease the dosage of NSAIDs. The prescription of tramadol is also made if NSAIDs are contraindicated or ineffective.[13] If a 'flare' is present in OA, an intra-articular injection can be considered, with glucocorticoids as the first choice. Glucocorticoids have a short term pain killing effect.

Non pharmacological treatment

Regarding the non-pharmacological treatment of patients with hip and/or knee osteoarthritis recommendations are formulated by the European League Against Rheumatism (EULAR)[28]: Similar recommendations are issued by the American College of Rheumatology (ACR)[29], the Osteoarthritis Research Society International (OARSI)[30], and are included in recent standards of care.
(http://www.eumusc.net/myUploadData/files/OA_Full_draft_FINAL[1].pdf)
According to these guidelines initial assessments should use a bio psychosocial approach, and treatment should be individualised according to the wishes and expectations of the individual, localisation of OA, risk factors (such as age, sex, comorbidity, obesity and adverse mechanical factors), presence of inflammation, severity of structural change, level of pain and restriction of daily activities, societal participation and quality of life. When lifestyle changes are recommended an individually tailored program should be provided. Patient education should include information regarding osteoarthritis, addressing maintenance and pacing of activity, a regular individualised exercise regimen, weight loss if overweight or obese, reduction of adverse mechanical factors (e.g. appropriate footwear), and consideration of walking aids and assistive technology.
Exercises should be provided and consisting strengthening, aerobic and range of motion exercises, with the aim to undertake these regularly on their own in their own environment and remain physically active.
Finally, working patients at risk of work disability or who want to start/return to work should have rapid access to vocational rehabilitation to maintain or improve social participation.

Multidisciplinary team care

In some cases the complexity of OA requires the involvement of multiple care providers at the same time. Such cases include the presence of psychosocial problems or comorbidity. Multidisciplinary team care for osteoarthritis is often provided in the hospital or rehabilitation setting. The coordination of multidisciplinary team care can be done by a rehabilitation physician, rheumatologist or orthopaedic surgeon, depending on the local treatment setting.

Surgical treatment

The orthopaedic surgeon can be involved in case of pain that cannot be influenced by (non)pharmacological treatment, severe and progressive loss of function and/or other possible indications such as instability of the joint.
In osteoarthritis of the knee there is an indication for 'nettoyage and lavage' by arthroscopy in case of blocking of the joint due to a loose body.
In medial or lateral knee osteoarthritis and therapy resistant complaints, an open or closed wedged correction osteotomy to relieve the medial or lateral compartment of the knee, can be considered.
Depending on the level of pain (especially in the night) and functional limitations total joint replacement surgery can be considered. By 2009, the numbers of patients undergoing Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA) have risen up to 1.6 and 1.2 per 1000 per year in Western countries.[31] In the Netherlands 55.000 THA and TKA are implanted annually.[32] These numbers are expected to further increase in coming years, due to the ageing society and the growing prevalence of obesity.[33]
Although the outcomes of THA and TKA are in general favourable with respect to outcome, still an unfavourable pain outcome was reported in 9% or more of patients after hip and about 20% of patients after knee replacement.[33] Predictors of worse outcome are higher age, female sex, morbid obesity (BMI > 40), worse physical, mental and social functioning, multiple joint involvement, and comorbidity.[34]

Comprehensive, stepped care management strategies

The combination of exercise therapy, self-management strategies, lifestyle advice, and pharmacological pain control are considered to be the cornerstones of the management of hip and knee osteoarthritis. Nevertheless, these conservative treatment options are found to be ignored in a considerable proportion of patients with hip and knee osteoarthritis, including those who are referred to undergo joint replacement surgery.[33,35-38]

The insufficient use of pharmacological and non-pharmacological treatment options may in part be related to the lack of detail regarding the adequate timing, combination and order of interventions in the currently available sets of recommendations.
An example of a comprehensive treatment strategy developed to overcome this problem is the 'Beating OsteoARThritis' (BART) strategy (Table 3).[39,40] This strategy describes what treatment is considered to be indicated in different stages of the disease course in hip and knee osteoarthritis. In the first step of BART treatment options consist of

education, life style advice, and acetaminophen; the second step exercise therapy, dietary therapy, and non-steroidal anti-inflammatory drugs; and the third step consists of multidisciplinary care, intra-articular injections, and transcutaneous electrical nerve stimulation. The BART is a patient-centered strategy which describes the possible treatment options irrespective which health care provider is providing this treatment. Depending on local situation and availability, health care providers can make agreements how and by whom necessary treatment options should be provided to the patient.

Knowledge gaps in the provision of physiotherapy in hip and knee osteoarthritis

Update of evidence

The overview of management strategies for hip and knee osteoarthritis makes it clear that physiotherapy is one of the key interventions. The provision of physiotherapy in patients with hip and knee osteoarthritis is recommended in national and international management guidelines.[11,13,28-30,,41]

Table 3 Summary of the recommendations in each step for the diagnostic procedures and assessment, treatment modalities, and evaluation according the BART (Beating osteoARThritis) strategy.

	Step 1	Step 2	Step 3
Diagnostic procedures and assessment	• Medical history and physical examination • Assessment function and activity limitations • Setting mutual goals	• Radiological assessment[a] • Assessment of pain coping and psychosocial factors • Adjust goals	• Consultation specialist • Adjust goals
Treatment modalities	• Education • Lifestyle advice • Medication[b] • Acetaminophen • Glucosamine-sulphate	• Exercise therapy • Dietary therapy • Medication[b] • (Topical) NSAIDs • Tramadol	• Multidisciplinary care • TENS • Medication[b] • Intra-articular injections
Evaluation	After 3 months[c]	After 3-6 months[c]	Patient sets interval

a: If there is a discrepancy between medical history and physical examination

b: Consult current guidelines for an adequate dose

c: Or earlier, if the symptoms persist or increas

A Dutch guideline on the management of hip and knee osteoarthritis specifically for physiotherapists had been developed 2001[42], but needed an update according to new insights into the physiotherapeutic assessment and treatment of these conditions, developed after 2001.[43-48] This update is also needed to address physiotherapy in joint replacement surgery, since physiotherapy is considered to be the gold standard to achieve functional independence and return to work and recreational activities after THA or TKA.[49]

Guideline adherence

It is more and more acknowledged that in general, the adherence of health care providers to clinical guidelines is poor.[50,51] Although some research into guideline adherence of physiotherapists existed[52,53], knowledge specifically on the adherence of physiotherapists with guidelines on the management of hip and knee osteoarthritis was lacking. By the time the investigations in this thesis started, indicators to measure specifically the quality of physiotherapy care for hip and knee osteoarthritis were not yet available. Derivation of such indicators from guidelines would be useful to measure guideline adherence, thereby serving as an instrument to evaluate and improve the quality of physiotherapy care.

Implementation

To improve adherence to guidelines, the use of active implementation strategies in addition to passive dissemination is recommended.[50,51] Education at the level of the professional is one of the strategies that can be effective to improve adherence.[54] However, it was unclear which educational approach would be most effective in the field of physiotherapy in hip and knee osteoarthritis. In particular, information on the effectiveness of an interactive educational approach to enhance guideline uptake regarding the physiotherapeutic management of hip and knee osteoarthritis was lacking.

Current physiotherapy practice in patients following hip and knee joint replacement surgery

The evidence on post-acute postoperative physiotherapy in patients following total hip and total knee replacement surgery has been scarcely incorporated into practice guidelines and recommendations.[55] Moreover, little information is available on the actual use of physiotherapy in daily practice before and after surgery, and to what extent recommendations are followed. This information is very important to identify targets for implementation strategies aimed at the increase of cost-effective physiotherapy interventions and the decrease of unnecessary treatments concerning rehabilitation before and after joint replacement surgery, in line with guideline recommendations. To get more insight into the use of physiotherapy in daily practice, various methods can be used, including review of medical records. Chart review would include referrals

to physiotherapists both by orthopaedic surgeons and general practitioners as well as information on treatment from physiotherapists' records. Still, the information would be incomplete, due to the possibility of self-referral (direct access to physiotherapy) and inadequate registration by health professionals. Therefore, information from both physiotherapists and patients is, although subjective, a useful and efficient method to obtain information.

Comorbidity

Finally, there are various concurrent medical conditions which are highly prevalent and affecting pain, physical functioning and health related quality of life in patients with hip and knee osteoarthritis undergoing THA and TKA surgery.[56-60] Although this knowledge is very relevant for the treating physiotherapist as well as physicians and other health care providers involved in the management of these patients, little information is available regarding the influence of specific and relevant comorbidities or the combination of those different relevant comorbidities on the outcomes of joint replacement surgery for hip and knee. More insight in the influence of relevant specific comorbidities and the combination of relevant comorbidities on outcome after surgery can give health care providers useful information for the management of hip and knee osteoarthritis to improve outcome after surgery.

Scope of this thesis

Given the abovementioned knowledge gaps the scope of this thesis is twofold:

- In the first part an update of a guideline for the physiotherapy treatment of patients with hip and knee OA is described.
- Then a set of quality indicators is developed to be used as an instrument to measure guideline adherence.
- Subsequently the effect of educational strategies to enhance their uptake by physiotherapists in daily clinical practice is investigated.
- The second part focuses on joint replacement surgery in hip and knee osteoarthritis. It describes the extent of the provision of physiotherapy before and after surgery from the physiotherapists' and patients' perspective.
- In addition the impact of specific and combined comorbidities on the outcomes after hip and knee replacement surgery in patients with hip or knee osteoarthritis is examined.

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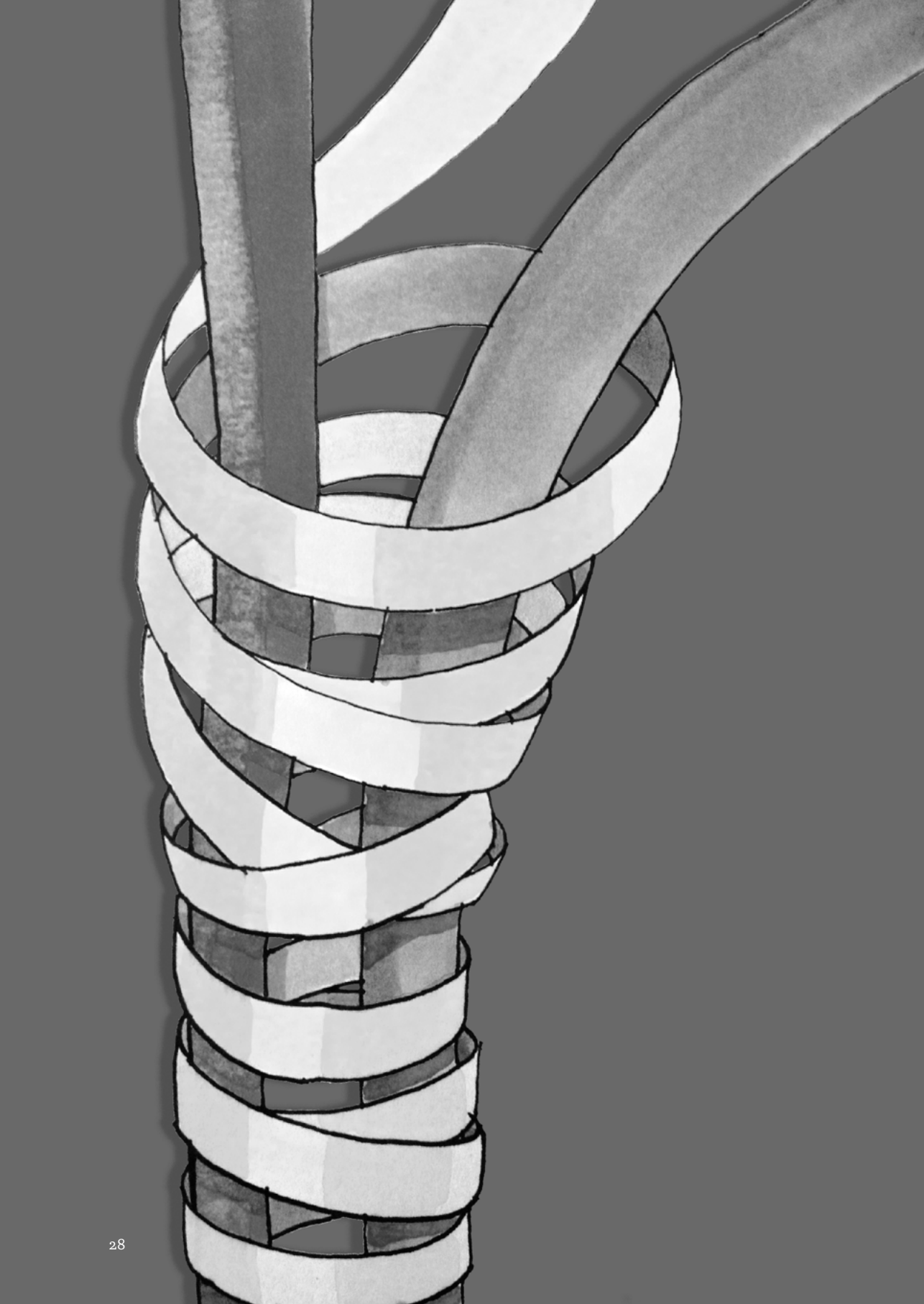

Chapter 2

Physiotherapy in hip and knee osteoarthritis: *development of a practice guideline concerning initial assessment, treatment and evaluation*

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Abstract

Background: An update of a Dutch physiotherapy practice guideline in Hip and Knee Osteoarthritis (HKOA) was made, based on current evidence and best practice.

Methods: A guideline steering committee, comprising 10 expert physiotherapists, selected topics concerning the guideline chapters: initial assessment, treatment and evaluation. With respect to treatment a systematic literature search was performed using various databases, and the evidence was graded (1-4). For the initial assessment and evaluation mainly review papers and textbooks were used. Based on evidence and expert opinion, recommendations were formulated. A first draft of the guideline was reviewed by 17 experts from different professional backgrounds. A second draft was field-tested by 45 physiotherapists.

Results: In total 11 topics were selected. For the initial assessment, three recommendations were formulated, pertaining to history taking, red flags, and formulating treatment goals. Concerning treatment, 7 recommendations were formulated; (supervised) exercise therapy, education and self-management interventions, a combination of exercise and manual therapy, postoperative exercise therapy and taping of the patella were recommended. Balneotherapy and hydrotherapy in HKOA, and thermotherapy, TENS, and Continuous Passive Motion in knee OA were neither recommended nor discouraged. Massage therapy, ultrasound, electrotherapy, electromagnetic field, Low Level Laser Therapy, preoperative physiotherapy and education could not be recommended. For the evaluation of treatment goals the following measurement instruments were recommended: Lequesne index, Western Ontario and McMaster Universities osteoarthritis index, Hip disability and Osteoarthritis Outcome Score and Knee injury and Osteoarthritis Outcome Score, 6-minute walk test, Timed Up and Go test, Patient Specific Complaint list, Visual Analogue Scale for pain, Intermittent and Constant OsteoArthritis Pain Questionnaire, goniometry, Medical Research Council for strength, handheld dynamometer.

Conclusions: This update of a Dutch physiotherapy practice guideline on HKOA included 11 recommendations on the initial assessment, treatment and evaluation. The implementation of the guideline in clinical practice needs further evaluation.

Introduction

The physiotherapist plays an important role in the health care process of the patients with hip and knee osteoarthritis and could be recommended, based on evidence in literature. In 2001 the KNGF Guideline for physiotherapy in patients with Hip and Knee Osteoarthritis (HKOA) of the Royal Dutch Society for Physiotherapy was developed. A revision was desirable, as since 2001 there has been a substantial increase of publications regarding clinical studies and national[1,2] and inter- national guidelines[3-7] on HKOA. Moreover, the existing Dutch physiotherapy guideline did not include recommendations on outcome measures, and did not provide recommendations on the pre- and postoperative management of patients undergoing hip or knee joint replacement. In addition, the existing Dutch physiotherapy guideline was not using the International Classification of Functioning, Disability and Health (ICF)[8] as a framework to systematically examine a patient's health status and to plan intervention strategies and their evaluation by standardized outcome measures.
The aim of the current revision was to describe evidence-based physiotherapy for HKOA, including initial assessment, interventions, and assessment of outcome, based on the ICF.

Methods

General methodology and Guideline Steering Committee

The revision of the guideline took place between September 2008 and January 2010, following national international methods for guideline development and implementation.[9] The guideline was developed by a Guideline Steering Committee comprising 10 expert physiotherapists. Based on the existing Dutch physiotherapy guideline on HKOA and relevant umbrella reviews, systematic reviews and guidelines published since 2001, two members (WP and TVV) proposed a preliminary list of topics to the Guideline Steering Committee. During a consensus meeting, 11 topics (3 for history taking and examination, 7 for treatment (interventions) and 1 for outcome measures) were selected.

Step 1: Literature search

A literature search was performed up to June 2009 in the MEDLINE, EMBASE, CINAHL, PEDro, Web of Science and Cochrane Library databases to identify systematic reviews, meta-analysis, and randomized controlled trials (RCTs). The central search strategy 'Osteoarthritis' (MESH) was combined with 'Hip' and 'Knee' and other MESH-headings and/or free text words such as 'physiotherapy', 'physiotherapy' (MESH), 'physiotherapy modalities' (MESH), 'exercise therapy', 'education', and 'self-management' (MESH). Studies were selected if sufficient data were reported with regard to the physiotherapy

treatment of HKOA patients. In case no systematic review or meta-analysis was found, RCTs were identified and selected for the therapeutic process. The quality of the RCTs was judged by two independent evaluators (WP and MJ) by using Delphi criteria.[10] Textbooks, review articles, umbrella review articles, and current guidelines on other, related conditions. With respect to the literature on examination and assessment, in addition to the systematic literature search, textbooks, review articles, and current guidelines on other, related conditions were used.

Step 2: Categorizing evidence
The selected literature was critically appraised by assessing the type and quality of the study design. Evidence was graded according to the EBRO (Evidence Based Recommendation Development) (see Table I), which is in line with international classification schemes[11], such as the NICE (National Institute of Clinical Effectiveness) approach. EBRO is an initiative of the Dutch Cochrane Center and the Dutch Institute for Healthcare Improvement (CBO), a member of the Guidelines International Network (GIN).[12]

Step 3: Strength of recommendations
By means of five consensus meetings and eight feedback rounds of the Guideline Steering Committee, recommendations were formulated and their strength graded A–D, based on the category of efficacy evidence (Table 1).

Table 1. From scientific evidence and expert opinion to recommendations according to the EBRO (Evidence Based Recommendation Development), which is in line with international classification schemes, such as the NICE approach.

Level of evidence	**1** One A1 study or at least two A2 studies **2** One A2 study or at least two B studies **3** One B or multiple C studies **4** Expert opinion
Grades of recommendation	**A1** Meta-analyses (systematic reviews), which include at least two Randomized Controlled Trials at quality level A2 that show consistent results between studies **A2** Randomized Controlled Trials of a good methodological quality (randomized double blind controlled studies) with sufficient power and consistency **B** Randomized Controlled Trials of a moderate methodological quality of with insufficient power, or non-randomized, cohort of patient-control group study involving intergroup comparisons **C** Patient series **D** Expert opinion

Step 4: Guideline review process
The first draft of the guideline was reviewed by a Guideline Review Committee, comprising 17 persons from various professional backgrounds was instituted, including rheumatologists, an orthopedic surgeon, rehabilitation specialists, general practitioners, and representatives of the Dutch Arthritis Foundation and the Arthritis Patient Organization. After adaptation, the second draft of the guideline was reviewed and pilot tested by 45 physiotherapists. Among them 15 were specialized and members of an arthritis network. Almost all of the physiotherapists agree with the content. Some minor comments concerning the feasibility of the measurement instruments, including lack of time and space to perform are taken into account in the implementation process after publication of the guideline.

Results

I. Initial assessment

In the Netherlands, physiotherapy can be accessed with or without a referral from a doctor (also called “direct access”). The initial assessment comprises history taking, physical examination and analysis. History taking and physical examination are performed to get a comprehensive overview of the patient’s health status. This assessment includes screening for red flags. The doctor must be consulted in case of a red flag after deliberation with the patient. With the analysis, the patient’s main limitations and impairments are prioritized, and treatment goals and a treatment plan are formulated, and in close collaboration with the patient, treatment goals are set, with the focus on limitations of activity and restriction in participation. The total initial assessment process is described in Figure 1.

Clinical question 1: In which way the patient’s health status can be assessed?
RECOMMENDATION 1:

- **The physiotherapist should assess the patient’s health status primarily in terms of activity limitations and participation restrictions (level 4).**
- **In addition, the therapist may also assess impairments of body function and structure, as well as personal and environmental factors, insofar as these relate to the limitations and restrictions (level 4).**

An overview of the most relevant health problems in HKOA patients was made, based on the short version of the International Classification of Functioning, Disability and Health (ICF) Core Set for Osteoarthritis[8], supplemented with clinical relevant items, best practiced based, and completed with a number of personal factors (Figure 2). This overview is recommended to be used for the setting of treatment goals, the formulation of the treatment plan and the evaluation.

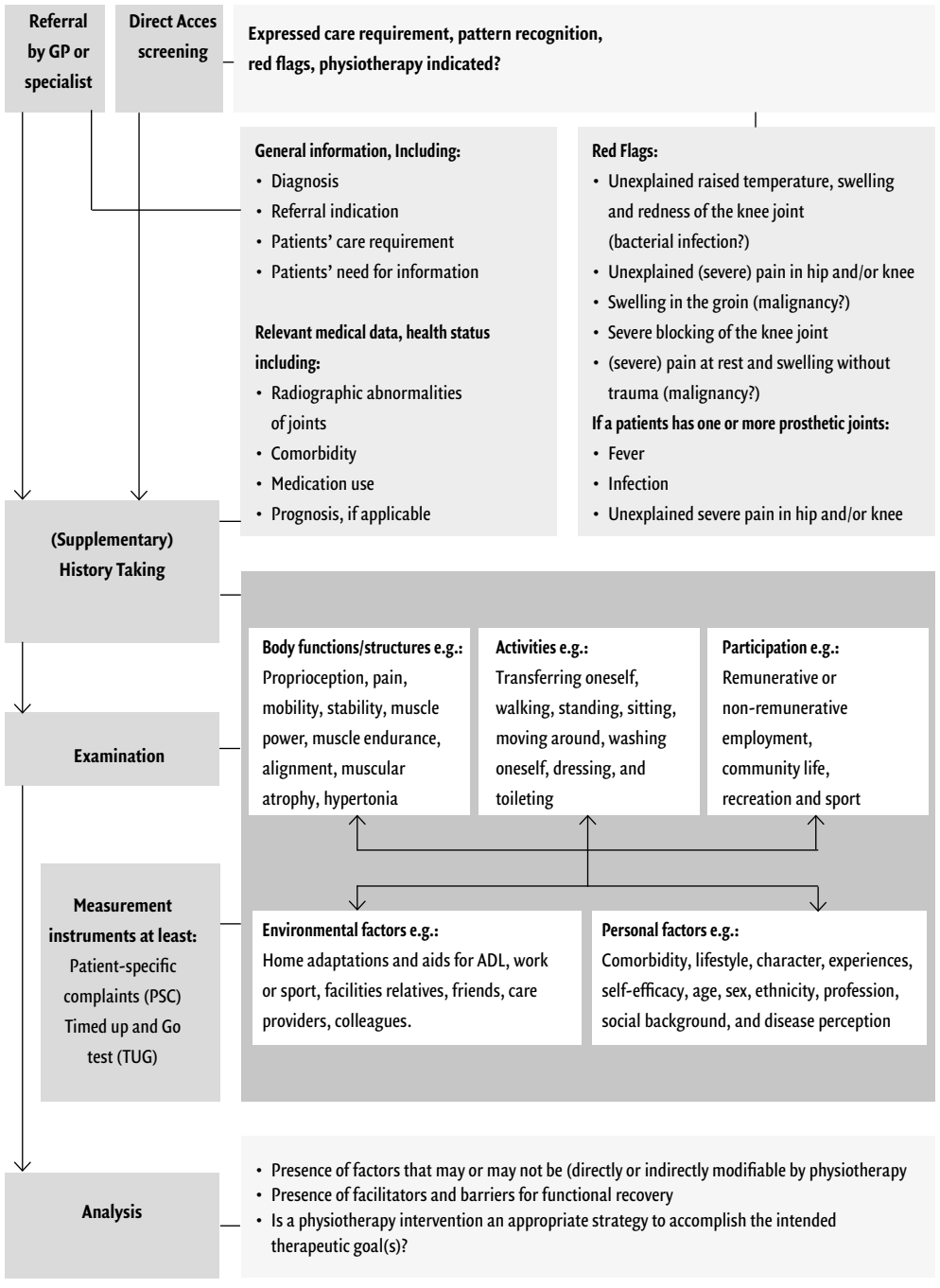


Figure 1. Description of the total initial assessment process

Clinical question 2: Which contraindications for physiotherapy should be taken into account in patients with HKOA?

RECOMMENDATION 2:

Physiotherapists should evaluate the presence of "red flags" (level 4).

The following specific red flags in HKOA patients were defined:

- A warm, swollen (red) knee joint
- A swelling in the groin
- Severe blockade of the knee joint
- (Extreme) pain at rest

And in the presence of one or more joint replacement prostheses:

- Fever
- Infection
- And inexplicable extreme pain in hip or knee joint.

Clinical Question 3: How does the physiotherapist set treatment goals?

RECOMMENDATION 3:

Based on information obtained in the initial assessment, in cooperation with the patient and according the ICF, the physiotherapist should define the therapeutic goals (level 4).

Based on of the description of the health status and the presence of barriers and facilitators,individual treatment goals should be defined. Goal setting is a shared process between the physiotherapist and the patient. Treatment goals are set in terms of the ICF, with the focus on limitations of activities and restriction in participation. Goals should be formulated according to the SMART principles (specific, measurable, achievable, realistic, and timed)[13], for example: being able to walk 800 meters (from home to the supermarket and back) two times a week in six weeks.

II. Interventions

With respect to the literature search concerning the therapeutic process, 22 systematic reviews and 74 RCTs (published after these reviews) were selected.

Clinical question 4: Which physiotherapy intervention should or should not be given in HKOA?

RECOMMENDATION 4:

(supervised) exercise therapy aimed at reducing pain and improving physical functioning should be applied during the physiotherapy treatment of HKOA patients (level 1).

Based on the literature exercises are recommended[14-18], but no specific intensity of exercises could be defined.[19] However, although there is a lack of evidence concerning the optimal type of exercises and their intensity, most research pertained to programs

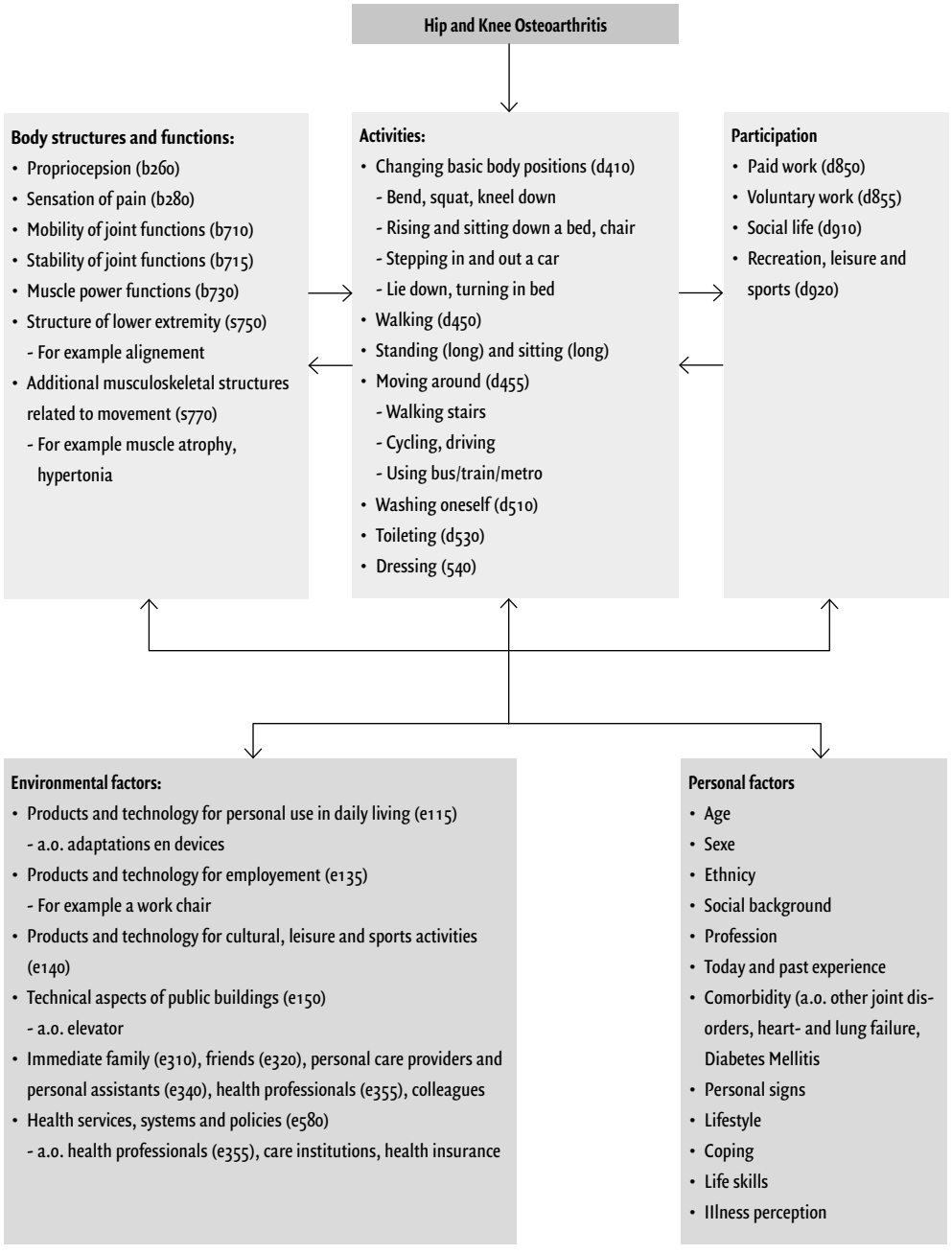


Figure 2. Overview of **the most relevant health related problems in hip and knee osteoarthritis patients**

including aerobic and/or muscle strengthening exercises, and possible combined with ROM and functional exercises. In previously published international multidisciplinary guidelines and a Dutch multidisciplinary guideline in HKOA management exercise therapy is recommended.[1] There are no recommendations on intensity, specific exercise forms, number of treatment or follow up sessions, and supervision.
In addition to the abovementioned recommendation on exercise therapy, there was overall consensus within the Guideline Steering Committee that exercises should comprise at least muscle strengthening exercises, exercises to improve aerobic capacity, functional exercises, and gait training, either as a single treatment or combined with each other, depending on treatment goals. The exercise program must have a focus on limitations of activities and restrictions in participation. In some cases the exercise therapy could be adjusted to individual treatment goals. For example joint proprioception and balance training[20] or a behavioural graded activity strategy.[21] Decreasing the frequency of treatment sessions at the end of the treatment is needed to help the patient to achieve an independent adequate level of physical activity. To improve the transition to recreational or sport activities the HKOA patient must be guided by the physiotherapist.

RECOMMENDATION 5:
Physiotherapists should provide education and promote adequate self-management in patients with HKOA (level 2).
Based on literature education and promotion of adequate self- management are recommended, provided in combination with exercise therapy (level 2).[22-27] Because of the variety of interventions in the literature, it is unclear which content of education or self-management intervention is best in HKOA. In international multidisciplinary guidelines and a Dutch multidisciplinary guideline in HKOA management education and self -management is recommended as an effective intervention as an adjunction to exercise therapy.[1,3-5] The Guideline Steering Committee recommend that the content of the intervention comprise the following items: knowledge and understanding of HKOA; the consequences of HKOA on functions, activities and participation; the relation between the mental and physical load and carrying capacity; the way to deal with complaints caused by HKOA; an active and healthy lifestyle (moving, nurturing, overweight); change in moving behavior; joint protection and the use of (walking) aids (level 4). The physiotherapist needs to support the patient in remaining a healthy physical activity level.

RECOMMENDATION 6:
Exercise therapy should be combined with manual therapy in cases of pain and reversible limitation in joint mobility (level 2).
If there is pain in combination with a limitation in joint mobility it is recommended to add manual therapy to exercise therapy (level 2).[28-32] In international multidisciplinary

guidelines and a Dutch multidisciplinary guideline in HKOA management, manual therapy is not mentioned or classified by exercise therapy.
In the Netherlands it is common to use the combination of exercise therapy with manual therapy. Within the Guideline Steering Committee there was consensus that manual therapy could be considered as a preparation for exercise therapy in HKOA in case of pain and a reversible limitation in joint mobility. The manual therapy should comprise manipulation, manual traction, and muscle stretching exercises in Hip OA. In Knee OA anterior/posterior mobilizations of the tibia-femoral joint and the patella, and muscle stretching exercises could be considered.

RECOMMENDATION 7:
Exercise therapy aimed at improving physical functioning should be applied after hip and knee joint replacement surgery (level 2).
Postoperative exercises are recommended in hip and knee joint replacement surgery and should comprise muscle strengthening exercises and exercises focusing on functional activities (level 2).[33-36] No recommendations on postoperative exercises are given in international guidelines in HKOA management. In a Dutch multidisciplinary guideline on hip and knee OA, postoperative exercise therapy is recommended.[1]

RECOMMENDATION 8:
Taping the patella should be adjusted to muscle strenghtening exercises and exercises focusing on functional activities to decrease pain in patella-femoral OA (level 2).
There is evidence to recommend taping in patella-femoral OA.[37,38] In international and Dutch guidelines included no recommendations on taping and patello-femoral OA. In the Netherlands often taping is used as a support to make it more possible to do exercises in patello-femoral OA.

RECOMMENDATION 9:
The provision of hydrotherapy, balneotherapy, thermotherapy, preoperative physiotherapy in HKOA, and transcutane electrical neurostimulation (TENS) in knee OA, and continuous passive motion (CPM) in postoperative knee OA, can neither be recommended nor discouraged (level 1,4)
There is conflicting evidence that hydrotherapy is effective in HKOA (level 1).[39-44] An international guideline (OARSI) recommends hydrotherapy in patient with hip OA[3].
In daily practice in the Netherlands hydrotherapy is used and experienced as a pleasant intervention by the patient. There was overall consensus within the Guideline Steering Committee that hydrotherapy could be applied in case of severe pain and no effect of alternative interventions as exercise therapy on land, medication or surgery. Hydrotherapy could also be used as preparation for exercise therapy on land in cases with severe pain.

There is also conflicting evidence that balneotherapy is effective in HKOA (level 1).[45-47] No recommendations are made in international and Dutch guidelines. In the Netherland it is no common intervention, but in some countries Spa therapy has a benefit in HKOA patient's physical and mental wellbeing.
There is some evidence that ice massage is effective as a cold application in knee OA.[48] An international guideline (OARSI) is mentioning that in some circumstances warmth or could applications could be beneficial in relieving pain.[5] There was overall consensus within the Guideline Steering Committee that an application of cold could be considered if there is severe pain in knee OA. The application of warmth could be considered as preparation for exercise therapy in patients with severe joint stiffness or difficulty in relaxing the muscles.
The Guideline Steering Committee advises against the use of local heat application in case of active joint inflammation which sometimes occurs in knee OA (level 4).
There is conflicting evidence that TENS is effective to relieve pain in knee OA (level 1).[49;50] An international guideline recommends TENS for the short term (OARSI) and a Dutch multidisciplinary guideline[1,5] recommend TENS to decrease pain and stiffness as a second choice if medication and exercises turned out to be not effective. The Guideline Steering Committee suggests that TENS could be considered as a support for exercise therapy in individual cases with severe pain but not as a first choice (level 4).
Concerning physiotherapy around joint replacement surgery there is conflicting evidence that CPM is effective after total knee surgery.[51-54] CPM is a common intervention after knee surgery to increase knee joint mobility. There is lack of evidence after knee surgery to recommend CPM according a Dutch multidisciplinary guideline.[1] The Guideline Steering Committee could not recommend or advise against CPM (level 1).
Preoperative exercises could not be recommended based on current evidence (level 3).[55-58] There are no recommendations mentioned in international guidelines on HKOA management. A Dutch multidisciplinary guideline could not recommend preoperative exercises1. But literature indicates that a good functional status before surgery is an important predictor on postoperative recovery. Within the Guideline Steering Committee there was an overall consensus that preoperative exercises could be considered in cases of poor preoperative status in patients with multiple comorbidity and other affected joints (level 4).
Finally preoperative education could be considered according the Guideline Steering Committee if there is much anxiety for the operation (level 4). The education should then be focused on information about the operation and the period the patient stays in the hospital.

RECOMMENDATION 10:
The provision of massage, ultrasound, electrotherapy, electromagnetic field, and Low Level Laser Therapy (LLLT), cannot be recommended in HKOA (level 1,2 4).

There is little evidence that massage is effective in knee OA (level 2).[59] In the Netherlands massage was a common physiotherapy intervention. Nowadays there is no place for massage in the active treatment strategy for HKOA. There is conflicting evidence for the use of ultrasound in knee OA (level 2).[60,61] The Health Council of the Netherlands (Gezondheidsraad) has advised against the use of ultrasound, except for the application in patients with a tennis elbow. Therefore the Guideline Steering Committee decided not to recommend ultrasound.

For electrotherapy there is conflicting evidence for the effectiveness in knee OA (level 3).[49,50] Electrotherapy is not common in the Netherlands as treatment for knee OA. Based on the current evidenced and best practice electrotherapy cannot be recommended.

No evidence can be found to support the use of electromagnetic field in de treatment of HKOA (level1).[50,62,63]

There is evidence that LLLT is effective in decreasing pain (level 1)[50], but it is a very uncommon intervention in the Netherlands. Further, there are other interventions that can be recommended to decrease pain why the Guideline Steering Committee did not recommend LLLT in knee OA (level 4).

In international and Dutch guidelines there are no recommendations for the use of massage, ultrasound, electrotherapy, electromagnetic field and LLLT in the treatment of HKOA.[1,3-7]

III. Assessment of outcome

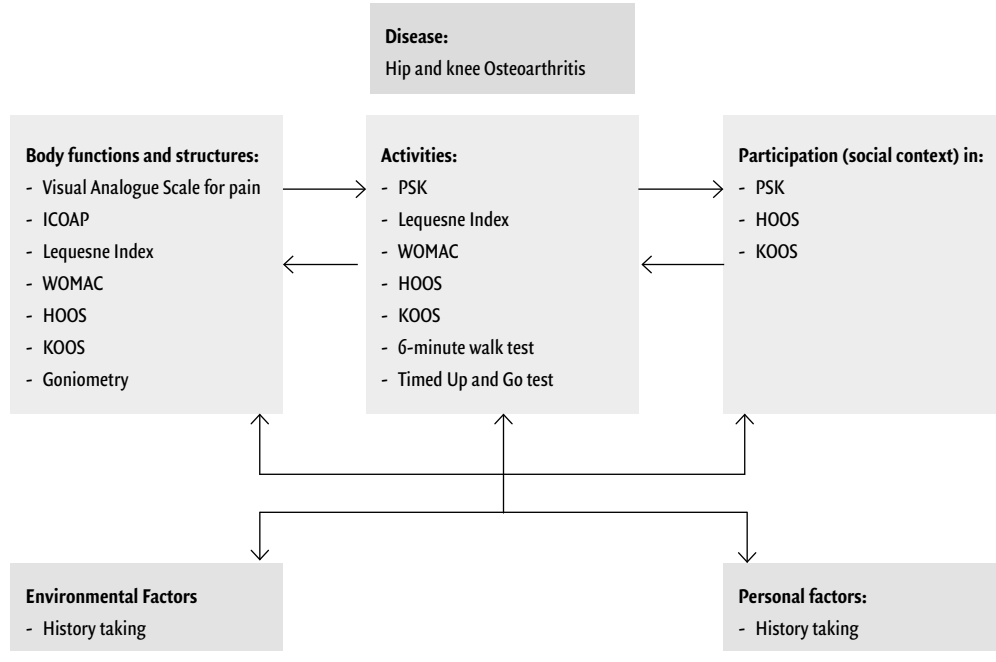
For the evaluation of treatment goals in HKOA patients several measurement instruments are available. Recommended measurement instruments pertained to ICF chapters activities and participation and body functions and structures and were chosen based on their applicability. The latter included the availability of a Dutch version must be available, no special training should be necessary and the measurement should have a good applicability in daily clinical practice. The measurement instruments classified according the ICF are shown in Figure 3.

Clinical question 5: Which measurement instrument should be used to evaluate treatment?

RECOMMENDATION 11:
A combination of questionnaires (preferably the patient specific complaint list (PSK)) and performance testing (preferably the Timed Up and Go test (TUG)) is recommended to use in the initial assessment and evaluating treatment goals and should have the focus on the ICF component in which the patient present his complaints.

The physiotherapists in the field prefer a recommendation for one or two best measurement instruments. Despite more measurement instruments are useful in daily practice depending on treatment goals, the Guideline Steering Committee prefer to recommend one questionnaire and one performance test. They were chosen primarily for their good applicability in daily practice: Patient Specific Complaint list In the Netherlands the PSK (Patiënt Specifieke Klachten) is developed[64] as an instrument to record patient specific complaints. The patient has to choose the three most limited activities from a list of activities in which patients can be limited because of HKOA. On a 100 mm visual analogue scale the degree of limitation can be outlined by the patient for each activity. With on the left end "no limitation in the activity" and on the right end "the activity is not feasible" the patient express how the degree of limitation of the activity is by means of a vertical line.

The score is determined by measuring the distance in millimeters from the left end of the line to the point that the patient marks. Timed Up and Go (TUG) test[65,66] measures



PSK = Patient Specific Complaint list, ICOAP – Intermittent and Constant OsteoArtritis Pain, WOMAC = Western Ontario and McMaster universities Osteoarthritis index, HOOS = Hip disability and Osteoarthritis Outcome Score, KOOS = Knee injury and Osteoarthritis Outcome Score, MRC = Medical Research Council

Figure 3. Measurement instruments **classified according the International Classification of Functioning, disability and health (ICF)**

the time in seconds in which the patient stand up from a chair, walk three meters, turn around, walk back and sit down on the chair. The test must take place in comfortable speed. Other measurement instruments that are recommended in HKOA patients are shown in Figure 2. In this figure the connections between the measurement instruments to the different components of the ICF are clarified. For measuring pain there is a choice to use two different scales: A Visual Analogue Scale (VAS) for pain[67] is usually a horizontal line of 100 millimeters. The VAS is filled in by the patient as described at the PSK. If the pain is intermittent, which occur in HKOA patient the Intermittent and Constant OsteoArthritis Pain (ICOAP)[68] could be used. This questionnaire is taken into account intermittent pain experience by the patient, for example in using pain medication by the patient. For measuring strength the use of a handheld dynamometer[67] is recommended or if that is not available, the Medical Research Council (MRC) for strength[69] is recommended as an alternative. The Range Of Motion (ROM) should be measured by using goniometry[70]. A Measurement instrument to measure walking and aerobic capacity is the 6 minute walk test.[65,66] During the 6-minutes' walk test the patients have to walk 6 minutes at a self-chosen walking speed and they have to try to overcome as much distance as possible, without running. The accomplished distance is the total distance at the end of the 6 minutes.

Finally to measure limitation in activities and restrictions in participation four different questionnaires are recommended. The choice between those four depends on the joint and the treatment goals. The Western Ontario and McMaster Universities osteoarthritis index (WOMAC)[71,72] measures limitations in activities as well as pain and stiffness in HKOA patients. The Lequesne index[73] has its focus on limitations in walking distance and pain during walking in HKOA. The HOOS[74] and the KOOS[75] ask besides limitation in activities also for restrictions in participation in sports and recreational activities and quality of life, respectively in Hip OA and Knee OA. Table II shows an overview of all recommendations.

Discussion

This study describes the development of a physiotherapy (PT) specific guideline for the management of HKOA. This guideline is based on recent research evidence and expert opinion. It was developed according to standardized procedures for formulating recommendations. The guideline describes the process of initial assessment, including PT interventions and various measurement instruments that can be used to evaluate treatment.

In contrast with other guidelines, this guideline gives recommendations on initial assessment and evaluation of treatment. The ICF framework[8] has a central place in this guideline. An overview is added concerning the ICF linked health related problems and measurement instruments. This linking on the ICF is also been used in two recently developed PT guidelines on hip osteoarthritis[76] and meniscal and articular cartilage lesions of the knee.[77]

Another difference between this guideline and other (multidisciplinary) guidelines on HKOA is that the recommendations are formulated not only based on literature but also considerations from daily practice are playing an important role in formulating recommendations. For example: although there is evidence that laser therapy could be effective in knee OA, it is not a common intervention in the Netherlands and furthermore the National Health Counsel (Gezondheidsraad) is not recommending the use of laser in knee OA patients. Concerning other interventions (hydrotherapy and thermotherapy) in which the evidence is sometimes weak, the guideline steering committee decided that the intervention only could be considered in specific individual cases after good clinical reasoning.

Among multidisciplinary guidelines ICSI Health Care[78] is giving annotations in the initial assessment. But in treatment they have a more passive approach since recommendations on electrical therapy and massage were given for pain relief, while this guideline has a clearly active approach without recommendations on passive modalities like massage, electrotherapy, laser, ultrasound and electromagnetic field.

Exercise, education and self-management interventions are overall recommended in national and international multidisciplinary guidelines on HKOA. For exercises and manual therapy the recommendations are comparable with those from the Ottawa panel.[79] Also TENS in knee OA is overall recommended. But this guideline is more cautious based on recent evidence.[49]

In contrast with other national[2] and international multidisciplinary guidelines on HKOA[3-7] this guideline gives recommendations concerning physiotherapy treatment before and after total hip or knee replacement in osteoarthritis. Only the Dutch multidisciplinary CBO guideline[1] comprise operative exercises based on expert opinion for example in case of worse physical status of the patient before surgery.

The MOVE consensus[7] mentions contra-indicators and barriers for exercise. The Dutch PT guideline pre-empt this by formulating general and specific red flags for HKOA. But these red flags are not only concerning exercises but also PT treatment in general. Besides barriers also facilitators which can influence outcome of treatment, are described.

Guidelines, recommendations and protocols on hip and knee will be available in many different countries, published or not. Discrepancies exist based on date (of publication) or the different national usual method of treatment. International cooperation between PT societies may be a following step in consensus on a guideline for the treatment of HKOA patients.

To facilitate the use of guidelines in daily practice it is important to apply an implementation strategy. Implementation studies with regard to other PT guidelines have shown

that didactic education and passive dissemination strategies were ineffective.[80] Multi-faceted interventions, interactive education and clinical reminder systems have been shown to be more effective to implement PT guidelines.[81] In a following study a more effective implementation strategy will be researched.

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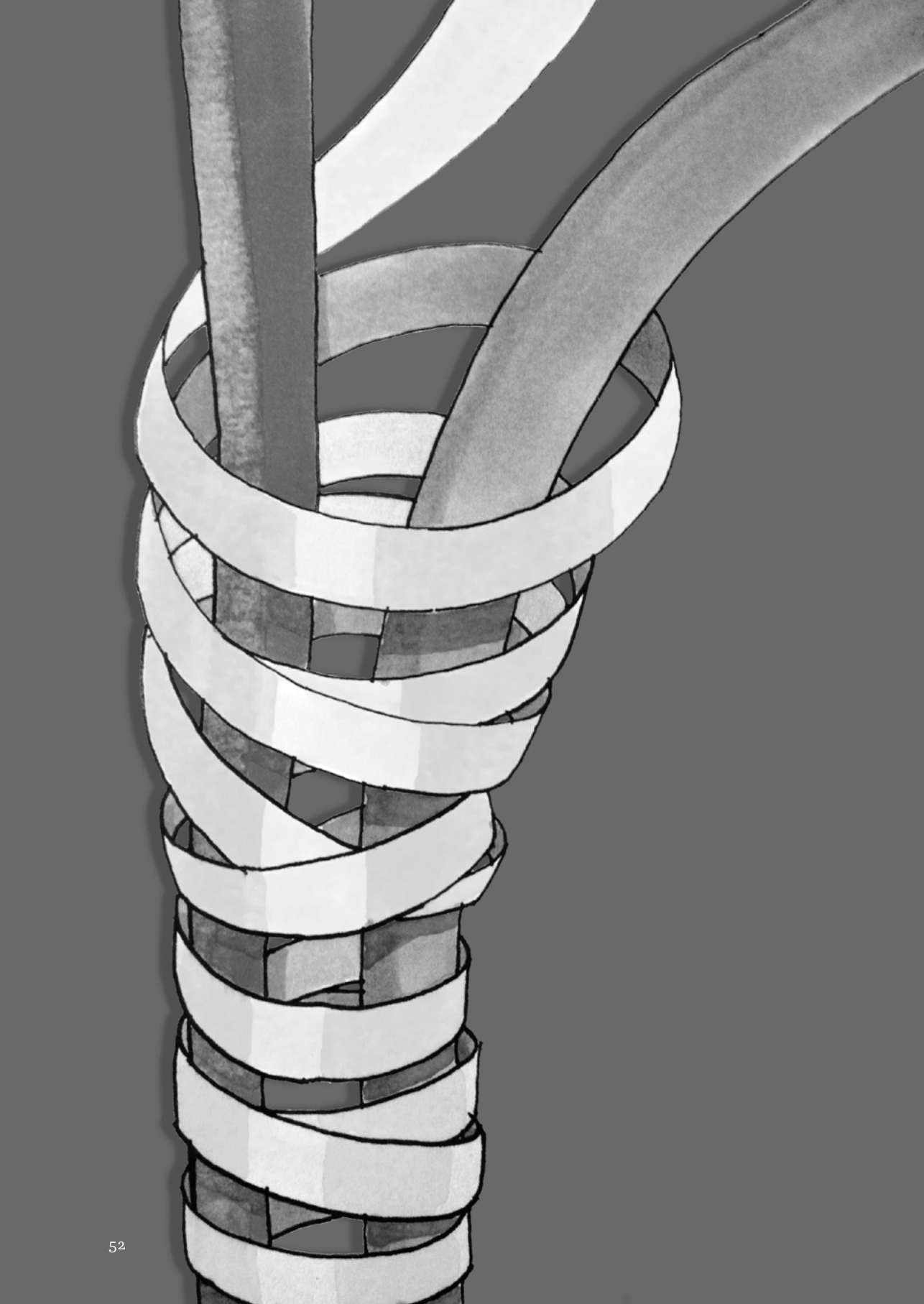

Chapter 3

Quality indicators for physiotherapy care in hip and knee osteoarthritis: *development and clinimetric properties*

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Abstract

Objective: The aim of the present study was to develop process quality indicators for physiotherapy care based on key recommendations of the Dutch physiotherapy guideline on hip and knee osteoarthritis (OA).

Methods: Guideline recommendations were rated for their relevance by an expert panel, transformed into potential indicators and incorporated into a questionnaire, the Quality Indicators for Physiotherapy in Hip and Knee Osteoarthritis (QIP-HKOA). Adherence with each indicator was rated on a Likert scale (0 = never to 4 = always). The QIP-HKOA was administered to groups of expert (n = 51) and general (n = 134) physiotherapists (PTs) to test its discriminative power. Reliability was tested in a subgroup of 118 PTs by computing the intraclass correlation coefficient (ICC). QIP- HKOA items were included if they were considered to be related to the cornerstones of physiotherapy in hip and knee OA (exercises and education), had discriminative power and/or if they were followed by <75% of PTs in both groups.

Results: Nineteen indicators were derived from 41 recommendations. Twelve indicators were considered to be the corner- stones of physiotherapy care; six indicators had discriminative power and/or were followed by <75% PTs in both groups, resulting in an 18-item QIP- HKOA. The QIP-HKOA score was significantly higher with expert (60.73; standard deviation (SD) 5.67) than with general PTs (54.65; SD 6.17) ($p < 0.001$). The ICC of the QIP-HKOA among 46/118 PTs was 0.89.

Conclusion: The QIP-HKOA, based on 18 process indicators derived from a physiotherapy guideline on hip and knee OA was found to be reliable and discriminated between expert and general PTs. Its ability to measure improvement in the quality of the process of physiotherapy care needs to be further examined.

Introduction

Osteoarthritis (OA) affects 9.6% of men and 18.0% of women older than 60 years of age.[1] OA occurs most commonly in the hip and knee. According to registrations at general practitioners' practices, in 2007 6.7% of the Dutch population was affected by hip or knee OA. Physiotherapy plays an important role in the management of patients with hip and knee OA and is recommended in a number of international multidisciplinary guidelines[2,3] and physiotherapy guidelines.[4,5] In 2010, an evidence-based update of the Dutch guideline for physiotherapy in hip and knee OA was developed.[6] The update was done according to standardized, international criteria[7] and based on the International Classification of Functioning, Disability and Health (ICF).[8] The updated guideline was distributed among members of the Royal Dutch Society for Physiotherapy (KNGF) and is freely accessible through the internet. (http://www.fysionet-evidencebased.nl/index.php/kngf-guidelines-in-english)

Concerning the implementation of guidelines in healthcare in general[9,10], and in physiotherapy in particular[11,12,13], several studies have demonstrated that guideline adherence is poor after dissemination by regular mail or through the website alone. To enhance their usage, implementation strategies, in addition to the afore- mentioned distribution methods, have been suggested, including educational meetings, group discussions and role playing.[14,15,16] To measure the effect of these strategies, a limited number of valid instruments are currently available. The use of quality indicators has been suggested as an appropriate method to estimate guideline adherence.[17] There are three different types of quality indicators; process indicators (e.g. applying a specific treatment modality), structure indicators (e.g. the availability of equipment or appointment systems) and outcome indicators (e.g. levels of functional disability, pain and satisfaction). Quality indicators should preferably be systematically derived from guidelines.[17,18]

For OA, only a limited number of sets of quality indicators for the multidisciplinary management of OA are available.[19,20] Currently, most sets of healthcare quality indicators for multidisciplinary management of OA and other rheumatic conditions use process indicators to assess quality of care.[21,22] Recently, a set of both process and outcome indicators specifically for the physiotherapy management of hip and knee OA was published.[23] However, this latter set pertained to the previous version of the Dutch physiotherapy hip and knee OA guideline and was not developed according to international recommendations.[17,18]

In the absence of an updated set of quality indicators for physiotherapy care in hip and knee OA, the aim of the present study was systematically to develop process indicators for quality physiotherapy care in hip and knee OA and to evaluate their reliability and discriminative power.

Methods

Study design

The development of the process quality indicators to assess guideline adherence was performed according to international criteria for the development of healthcare quality indicators.[17,18] The developmental process was part of a study to compare the effectiveness of two educational courses as an implementation strategy for a Dutch physiotherapy guideline on hip and knee OA. The study was conducted in accordance with the Good Clinical Practices protocol and Declaration of Helsinki principles (http://www.wma.net/en/30publications/10policies/b3/). According to Dutch law, the anonymous completion of a questionnaire to evaluate an educational intervention, as employed in the present study, does not fulfil the definition of medical scientific research. To ensure ethical conduct in the study, we followed the procedure that had been used in a similar study performed by our group in medical students.[24] This procedure had been developed in agreement with the academic hospital's medical ethics adviser. In line with this procedure, in the cur- rent study the physiotherapists (PTs) who filled in the questionnaires were informed that their data would be made anonymous and then used for a study on the effectiveness of education on the Dutch physiotherapy guideline on hip and knee OA. They were invited to express any disagreement with this procedure and given the assurance that, if they disagreed, their data would be removed from the database. Following this procedure, no disagreement was expressed by any of the PTs in the present study.
The process indicators were developed from April to August 2010 (steps 1–4), whereas the examination of their clinimetric properties was executed from September to December 2010 (step 5).

Table 1. Steps in the development process of quality indicators for physiotherapy in hip and knee osteoarthritis

Step 1.	Deriving potential indicators from the guideline
Step 2.	Prioritization of indicators by an expert panel (potential contribution to quality of care, acceptability and measurability for daily practice)
Step 3.	Operationalization of prioritized indicators into a questionnaire "Quality Indicator for Physiotherapy in Hip and Knee Osteoarthritis" (QIP-HKOA)
Step 4.	Pilot testing the initial QIP-HKOA by physiotherapy experts and experts in development tests (clarity and completeness)
Step 5.	Testing the adjusted QIP-HKOA on relevant clinimetric properties (internal consistency, reliability and discriminative power)

Development of the process indicators

The development was carried out according to five consecutive steps (see Table 1).

Step 1. Deriving potential indicators from the guideline

All recommendations in the guideline were listed and transformed into potential process indicators. For this purpose, the recommendations were reformulated into more concise items. This was done by the lead author of the guideline (WP), with feedback from all co-authors of the revised guideline[6] (Peter et al., 2011).

Step 2. Prioritization of indicators by an expert panel

An expert panel of 16 PTs experienced in the treatment of hip and knee OA patients and working in primary (n = 9) or secondary (n = 7) care was formed. These PTs had more than ten years' experience in treating OA patients and followed advanced training courses concerning arthritis management. They were asked by email to rate the relevance of each recommendation with respect to its potential contribution to quality of care, acceptability and measurability for daily practice. For each recommendation there were four categories to rate relevancy, ranging from 'not relevant' to 'very relevant'. Recommendations were considered relevant if at least 12 of the 16 experts (≥75%) had rated the item as 'relevant' or 'very relevant'. In this step, the decision was made to select only recommended items concerning diagnosis, treatment or evaluation, whereas items that were neither recommended nor advised against or were not recommended, were excluded.

Step 3. Operationalization of prioritized indicators

In the third step, the initial set of Quality Indicators for Physiotherapy in Hip and Knee Osteoarthritis (QIP-HKOA) questionnaire was developed. Relevant recommendations (from step 2) were translated into questions by an expert PT (WP). For each item, adherence was measured using a five-point Likert scale: 0 = never, 1 = seldom, 2 = sometimes, 3 = generally and 4 = always.

Step 4. Testing the initial QIP-HKOA

The fourth step was for the draft questionnaire to be pilot tested with respect to clarity and completeness by 15 PTs working in primary care and three experts in the development of tests (JV, ZJ and LBV). The three experts were all involved in educational courses for medical and healthcare professionals, and the development of tests or examinations to assess the results of the educational courses. Inconsistencies in the questionnaire were resolved. Finally, the adjusted QIP-HKOA was converted into an online version.

Step 5. Testing the clinimetric properties of the adjusted and final versions of the QIP-HKOA

To be able to determine the clinimetric properties of the adjusted QIP-HKOA, a distinction was made between expert and general PTs, based on their level of advanced practice education regarding arthritis management (including OA). We hypothesized that adherence to quality indicators would increase with the level of advanced education in arthritis management. For the purpose of the present study, PTs who completed the only postgraduate advanced arthritis course available in the Netherlands (i.e. the 10-days certified Dutch arthritis education provided by the Dutch Institute of Allied Health Care), were regarded as experts.[25] PTs who did not complete any additional course in arthritis care were considered as general PTs. Those who did follow some kind of additional course in arthritis care, but not to the level of the advanced course, were designated as PTs who met neither expert nor general PT criteria. Their data were used to compare the results of the final QIP-HKOA with those of both expert and general PTs.

To obtain sufficient numbers of expert PTs as compared with general PTs, participants were recruited from three samples:

A. Regional physiotherapy rheumatology networks

From three Dutch networks[25], expert PTs (N= 98) with a special interest and/or specific knowledge and skills regarding the treatment of patients with rheumatic diseases in the Netherlands were selected.

B. PTs who subscribed to an educational course on hip and knee OA

One hundred and eighteen PTs, who subscribed to a single, three-hour educational course organized in the context of the publication of the Dutch physiotherapy guideline on hip and knee OA, were selected.

C. A national registry of PTs

A random sample from the nationwide KNGF registry system of 200 PTs was taken by means of digital number allocation, with the highest 200 numbers subsequently being selected. To develop the final version of the QIP-HKOA, items were included if they were considered to be the cornerstone of physiotherapy management in hip and knee OA (exercise and patient education) and/or the proportion of PTs who generally or always applied them was statistically significantly different between expert and general PT groups, and/or were followed by <75% of them in both groups.

Procedure regarding the administration of questionnaires

All participating PTs were sent a hyperlink to the online version of the questionnaire by email. Participants of sample B were invited to complete the questionnaire at two different time points, within seven days, to determine the test–retest reliability.
In addition to the questionnaire and the information on arthritis education, the following information was gathered from all participating PTs: age, gender, work setting, years of physiotherapy experience, and number of patients with hip and/or knee OA treated during the previous three months. To optimize the level of response, two reminders were sent by email after three and five weeks to those who did not respond.

Data analysis

The sociodemographic characteristics of all participants in the study were compared between the three groups by of analysis of variance (ANOVA) or Chi-square tests, where appropriate. In cases where there was a statistically significant difference, pairwise comparisons between different combinations of two groups were done by means of unpaired t-tests or Mann–Whitney U tests, and Chi-square tests, where appropriate. Statistical comparisons of the proportions of PTs generally or always applying a specific procedure between general and expert PTs were done per item of the adjusted QIP-HKOA by means of the Chi-square test, as part of the development of the QIP-HKOA (step 5). Finally, to test the discriminative power of the final QIP-HKOA, the total mean score of the final QIP-HKOA was compared among expert and general PTs, as well as the PTs who did not meet either criterion by means of an ANOVA using the same procedure as described above. To examine the test–retest reliability, the ICC (average measures) was calculated. Cronbach's a was computed for internal consistency. According to Kline[26], Cronbach's a ≥ 0.9 = excellent; 0.8 ≤ a <0.9= good; 0.7 ≤ a <0.8 = acceptable; 0.6 ≤ a < 0.7 = questionable; 0.5 ≤ a < 0.6= poor; a < 0.5 = unacceptable.
Data were analysed using the SPSS statistical package (version 18.0, SPSS, Chicago, IL, USA). The level of statistical significance was set at p≤0.05 for all the analyses.

Results

In total, 243 PTs participated in the present study. There were no differences in baseline characteristics between expert PTs (N= 51), general PTs (N=134) and the PTs who met neither expert nor general PT criteria (N=58) (see Table 2).

Deriving potential indicators from the guideline (step 1)

Forty-one recommendations were identified in the Dutch physiotherapy guideline in hip and knee OA[6] (Peter et al., 2011), and translated into concise items if necessary.

Prioritization and operationalization of indicators (steps 2 and 3)

Based on lack of relevance, 12 recommendations concerning interventions were excluded by the expert panel. These recommendations concerned interventions which could

Table 2. Baseline characteristics of 243 physiotherapists (PTs) participating in a study on the development of quality indicators related to a physiotherapy guideline on hip and knee OA

	Expert physiotherapist (N=51)	Neither Expert nor General physiotherapist (N=58)	General physio-therapists (N=134)	P-value
Age, years (mean, SD)	45.3 (9.7)	43.1 (11.7)	43.7 (10.7)	0.57#
Gender, Females (%)	32 (62.7%)	40 (69.0%)	81 (60.4%)	0.53*
Work setting				
primary care	38 (74.5%)	36 (62.1%)	97 (72.4%)	0.27*
hospital/rehabilitation center/nursing home	13 (25.5%)	22 (37.9%)	37 (27.6%)	
Experience				
0-10 years	18 (35.3%)	20 (34.5%)	57 (42.5%)	0.47*
more than 10 years	33 (64.7%)	38 (65.5%)	77 (57.5%)	
Number of OA patients treated past three months				
0-10	39 (76.5%)	43 (74.1%)	106 (79.1%)	0.74*
more than 10	12 (23.5%)	15 (25.9%)	28 (20.9%)	

One way ANOVA for 3 groups

* Chi-square test over 3 groups

Table 3. Cohorts, eligible and responding physiotherapists used in testing the clinimetric properties of the QIP-HKOA

Cohorts of physiotherapist from which participants were derived	**Number of physiotherapists who were asked to fill in the questionnaire**	**Number of physiotherapists who finally filled in the QIP-HKOA and response rate**		
		Number of expert physiotherapists	Number of neither expert, nor general physiotherapists	Number of general physio-therapists
A. Regional physiotherapy rheumatology networks (N=98)	80 physiotherapists followed an advanced educational course	30 (38%)		
B. Physiotherapists who subscribed to an educational course on hip and knee OA (N=118)	118	21 (18%)	58 (49%)	39 (33%)
C. A national registry of physiotherapists (N=200)	150 physiotherapists who did not followed any educational course			95 (63%)
Total number of responding physiotherapists		51	58	134

not be recommended or advised against or should only be considered in some (small) subgroups of patients. In addition, ten other recommendations concerning measurement instruments were excluded because they were optional to use, depending on the individual patient's health status and preferences. The remaining 19 recommendations were divided into those on initial assessment (three items), therapy (12 items) and evaluation of treatment (four items), and translated into concept quality indicators for the questionnaire (initial QIP-HKOA). The 12 items concerning therapy were related to exercises, patient education and promoting adequate self-management and were all considered to form the cornerstone of physiotherapy management by the expert panel.

Testing the initial QIP-HKOA (step 4)

After correction for clarity and completeness by 15 expert PTs and three experts in the development of tests (ZJ, JV and LB), the adjusted QIP-HKOA was constructed.

Clinimetric properties of the adjusted and final versions of the QIP-HKOA (step 5)

In total, 51 expert PTs (30 from cohort A and 21 from cohort B), 134 general PTs (39 from cohort B and 95 from cohort C) and 58 PTs who were considered to be neither expert nor general PTs were included in the study. Table 3 shows the characteristics of the three cohorts and the response rates.

Clinimetric properties of the adjusted version of the QIP-HKOA

Table 4 shows the proportions of PTs indicating that they frequently (regularly and always) or infrequently (sometimes, seldom and never) adhered to individual items from the adjusted QIP-HKOA. According to the results, one item was excluded (item 2: Assessing the presence of personal and environmental problems, insofar as these relate to the limitations in activities and restrictions in participation), as it was not part of the cornerstone of physiotherapy management, there was no significant difference in the proportion of PTs generally or always applying it between expert and general PTs, and it was followed by >75% in both groups. Thus, the final questionnaire contained a set of 18 quality indicators, indicated as the final QIP-HKOQ (total score range 0–72).

Clinimetric properties of the final QIP-HKOA

The mean final QIP-HKOA total score was significantly higher for expert PTs (60.73; SD 5.67) than for general PTs (54.65; SD 6.17) ($p<0.001$), whereas the score for the group who did not meet the criteria for either expert or general PTs was intermediate (56.55; SD 6.54). The p-value of the ANOVA was <0.001, with the pairwise comparisons of expert versus general PTs and expert PTs versus those who did not meet either criteria reaching statistical significance ($p<0.001$). The comparison of the final QIP-HKOA total score between general PTs and those who did not meet either criteria was not statistically significant ($p = 0.14$).

Table 4. Items of the questionnaire to assess adherence to the Dutch physiotherapy guideline in patient with hip and knee osteoarthritis.

	Expert physio-therapists (N= 51)	Neither expert nor general physio-therapist (N=58)	General physio-therapist (N= 134)	P-value [1]
A. Diagnostic Process				
1. Inventory of health related problems according the ICF.*	82.4% (42)	60.3% (35)	44.8% (60)	< 0.001
2. Assessing the presence of personal and environmental problems insofar as these relate to the limitations in activities and restrictions in participations.#	96.1% (49)	93.1% (54)	95.5% (128)	0.87
3. Assessing the presence of hip and knee osteoarthritis specific "red flags".*	98.0% (50)	96.6% (56)	88.8% (119)	0.05
B. Treatment Process				
4. Treating patients with strengthening of muscles.***	100.0% (51)	98.3% (57)	98.5% (132)	0.38
5. Treating patients with improving of aerobic capacity.***	80.4% (41)	82.8% (48)	77.6% (104)	0.68
6. Treating patients with walking exercises.***	88.2% (45)	87.9% (51)	83.6% (112)	0.43
7. Treating patients with functional exercises.***	96.1% (49)	98.3% (57)	94.0% (126)	0.58
8. Treating patients with postoperative exercises.***	94.1% (48)	94.8% (55)	91.8% (123)	0.59
9. Providing information concerning knowledge and understanding of osteoarthritis of hip and/or knee.***	100.0% (51)	98.3% (57)	97.8% (131)	0.28
10. Providing information concerning the consequences for the patient's functional performance in terms of movements, activities and participations.***	100.0% (51)	94.8% (55)	94.8% (127)	0.10
11. Providing information concerning the relation between burden and tolerance level.***	100.0% (51)	98.3% (57)	99.3% (133)	0.54
12. Providing information concerning the way a patient copes with health problems. ***	100.0% (51)	93.1% (54)	94.8% (127)	0.10
13. Providing information concerning what constitutes an active and healthy lifestyle (in terms of exercise and nutrition/overweight.***	96.1% (49)	93.1% (54)	93.3% (125)	0.47
14. Providing information concerning behavioral change (regarding physical activity).***	96.1% (49)	89.7% (52)	93.3% (125)	0.47
15. Providing information concerning joint protection and the use of aids.** / ***	62.7% (32)	67.2% (39)	60.4% (81)	0.78
C. Evaluation Process				
16. Evaluating treatment with the recommended measurement instruments.*	68.6% (35)	51.7% (30)	35.8% (48)	< 0.001
17. Evaluating treatment with the combination of a questionnaire and a performance test.*	58.8% (30)	32.8% (19)	23.9% (32)	< 0.001
18. Evaluating treatment with Patient Specific Complaint list (PSK).*	78.4% (40)	62.1% (36)	52.2% (70)	0.001
19. Evaluating treatment with the Timed Up and Go test (TUG).*	45.1% (23)	27.6% (16)	15.7% (21)	< 0.001

* Included (P < 0.05)
** Included based on adherence with recommendations < 75%
*** Included: cornerstones of physiotherapy management in hip and knee OA
\# Excluded because significant discriminative power is lacking, not being a cornerstone of physiotherapy management, and adherence with recommendation > 75% in both groups
1 Chi-square test between expert and general physiotherapy

Among the 46 sets of questionnaires which were completed twice by the same participant, there was a high correlation between the mean scores at the two time points [respectively, 67.15 (SD 5.28) and 67.78 (SD 5.96)], with an ICC (average measures) of 0.89 (95% confidence interval 0.80–0.94).
For internal consistency of the final QIP-HKOA, the scores from all responding PTs (N= 243) were used, with Cronbach's a being 0.63, which is, according to the criteria formulated by Kline[25], considered questionable.

Discussion

The present study describes the development of process indicators for physiotherapy care from an updated Dutch evidence-based guideline for the physiotherapy management of hip and knee OA. The resulting questionnaire, the QIP-HKOA, comprised 18 process indicators and demonstrated good test–retest reliability and moderate internal consistency.
A direct comparison between the present set of process indicators and similar sets is difficult. In contrast to the present set, the process indicators derived from an earlier version of the guideline[23] were not developed according to international standards.[17,18] First, there were methodological differences in the developmental process. Second, the current set of quality indicators only comprises process quality indicators, whereas the set by Jansen et al. comprised outcome indicators as well. Most likely due to these differences, both sets of indicators vary with respect to their content. An example is the provision of aftercare, pertaining to the referral of patients to regular community exercise and sports activities after a period of supervised exercises, which is recommended in both the previous and the updated versions of the guideline. This topic is included in the set by Jansen et al[23], but not in the present set, as it was removed in step 2 of the development process. The reason for exclusion was its perceived lack of relevance by the expert panel. On the other hand, the current set of indicators included the application of outcome measurement instruments which were not incorporated in the previous set, in spite of the fact that they were recommended. The differences indicate that the scope and development process of quality indicators may influence their eventual inclusion, but also suggest that the inclusion or exclusion of topics according to their relevance is a subjective process. To make the appropriate choices, feedback from a larger group of stakeholders than the expert panel involved in the present study is probably needed.
The present study also tested the indicators with respect to clinimetric properties. The finding of adherence with items related to exercise and education, generally considered to be the cornerstones of physiotherapy in hip and knee OA, may indicate that the delivery of these interventions is already common practice. Other researchers have also found that this approach is generally adopted.[27] However, as guidelines are relatively unclear about the required contents, intensity, frequency and mode of delivery of exercise, it is

still possible that variations in quality with respect to these interventions do exist.
Until now, process indicators to assess the quality of physiotherapy care have only been systematically developed in the Netherlands for the national physiotherapy guideline on Parkinson's disease.[28] These indicators were incorporated into a questionnaire using a similar procedure to that employed in the present study. The development of other sets of quality indicators derived from Dutch physiotherapy guidelines and pertaining to low back pain[14] and ankle sprain.[16] The sets on ankle sprain and low back pain included process indicators and outcome indicators that were not directly derived from guideline recommendations. In both studies, a questionnaire containing quality indicators was used, but not tested with respect to their clinimetric properties.
The present study had a number of limitations. Using a questionnaire like QIP-HKOA is one way to measure adherence to guideline recommendations. Alternative methods to assess guideline adherence include assessing patient files, retrieving data from a computerized patient database, using vignettes or carrying out a script concordance test. The latter method could be more suitable when clinical reasoning plays an important role in using the guideline in daily clinical practice.[29]
Furthermore, the use of process indicators may not reflect the full spectrum of quality of care, which also includes structure and outcome.[17] However, most sets of healthcare quality indicators focus on process indicators, as data to underpin the usage of structure and outcome indicators are scarce.[21,22] In the process of formulating potential indicators, the expert panel did not take into account the level of evidence underlying the recommendations. As a result, recommendations based on expert opinion (level 4) were also included. It is a matter for debate whether a minimum level of evidence is required for recommendations to be included in sets of process indicators. Moreover, no statements about items which cannot be recommended were included. Another limitation was the monodisciplinary composition of the expert group. As a next step, it would be desirable to construct a group containing all relevant healthcare providers, including disciplines other than physiotherapy, and also patient representatives, according to recommendations published by Wollersheim et al[18] and the RAND/UCLA method (http://www.rand.org/content/dam/rand/pubs/monograph_reports/2011/MR1269.pdf).
Finally, it remains to be established the extent to which our results are generalizable to all PTs, as the present study was performed in only one country, the response rate was moderate and selection bias could have played a role. PTs willing to participate in the present study were probably more likely than a random selection of PTs to follow the guideline. In particular, the PTs from cohort B, who subscribed to an educational course on the guideline, might not have been representative of all PTs. In general, by using a questionnaire to determine adherence, there is a chance of obtaining socially desirable answers. This could probably have led to an overestimation of adherence in all groups. In addition, the distinction between expert and general PTs based on their advanced arthritis training level was arbitrary, even though it had been used in a previous study.[25]

Conclusions

The present study describing the development of process indicators for the physiotherapy management of hip and knee OA contributes to the further development of quality indicators at the level of physiotherapy care because of the multidimensionality of the indicators (diagnostic, therapeutic and evaluative items). To assess the quality in physiotherapy care for hip and knee OA in general, adjustments could be made concerning aftercare or referring patients to regular community exercise.

Clinical messages

- **Process indicators for the physiotherapy management of hip and knee OA were developed and transformed into a questionnaire (QIP-HKOA).**
- **The QIP-HKOA was found to be reliable, had discriminative power and was able to give indications about how to improve the quality of the process of physiotherapy care.**

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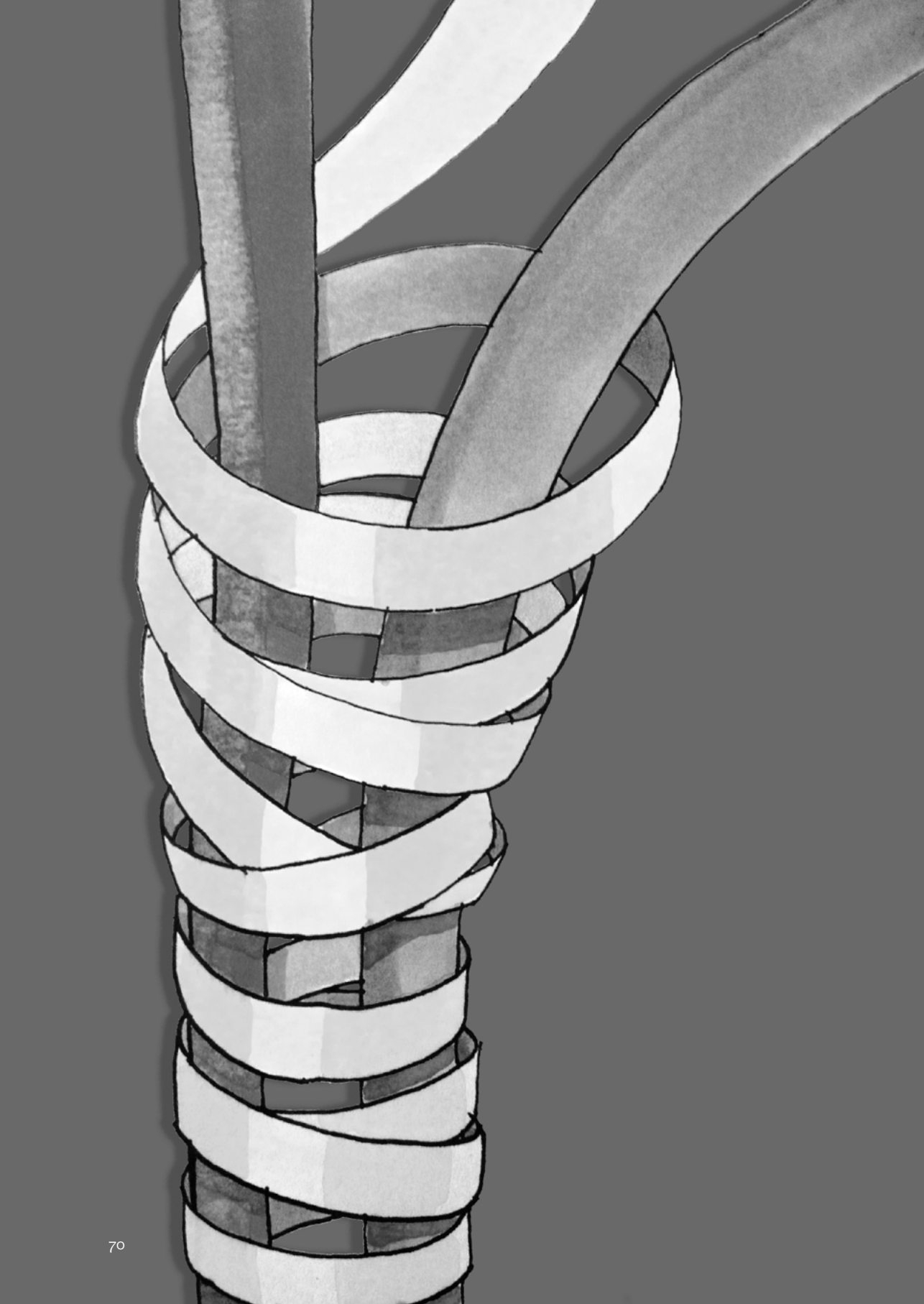

Chapter 4

Postgraduate education to increase adherence to a Dutch physiotherapy practice guideline for hip and knee OA: *a randomized controlled trial*

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Abstract

Objective: To compare the effectiveness of two educational courses aiming to improve adherence to recommendations in a Dutch physiotherapy practice guideline for hip and knee OA.

Methods: Physiotherapists (PTs) from three regions in The Netherlands were invited to participate in a study comparing an interactive workshop (IW) with conventional education (CE). Participants were randomly assigned to one of the two courses. Satisfaction with the course (scale 0-10), knowledge (score range 0-76) and guideline adherence (score range 0-72) were measured at baseline, immediately after the educational course and 3 months after that. Data were analysed using a linear mixed model.

Results: In total, 203 (10%) PTs participated in the IW (n = 108) and the CE (n = 95). There were no differences between groups at baseline. Satisfaction was significantly higher in the IW than in the CE group [mean scores (S.D.) 7.5 (1.1) and 6.7 (1.6), respectively (P<0.001)]. A significantly greater improvement in adherence was seen over time in the IW group compared with the CE group (F = 3.763, P = 0.024), whereas the difference in improvement of knowledge was not significant (F = 1.283, P = 0.278).

Conclusion: An interactive workshop led to greater satisfaction and was more effective in improving adherence to recommendations in a PT guideline on hip and knee osteoarthritis.

Introduction

For patients with OA, new strategies to optimize conservative and surgical treatment have been developed over the past years. The new insights are reflected in numerous guidelines and recommendations on the management of OA, which were developed by various international and national scientific societies and health care organizations.[1-7] Although it is generally acknowledged that the introduction of guidelines and recommendations improves the quality of care, unsatisfying adherence to clinical guidelines has often been reported.[8-12] To improve adherence to guidelines, the use of active implementation strategies in addition to passive dissemination is recommended.[8-11] These active strategies can be aimed at the level of the professional (e.g. professional education), the organization (e.g. adaptation of working processes), the context (e.g. adequate funding) or the patient (e.g. patient information).[8] With respect to active implementation strategies for guidelines aimed at the professional, the provision of educational courses is a common option. [12] In a Dutch physiotherapy guideline on low back pain, an active implementation strategy showed more effectiveness than passive dissemination of the guideline.[13,14] Evaluations of traditional presentations on physiotherapy guidelines showed that the attending physiotherapists (PTs) were satisfied overall, but preferred a more practical approach.[12]
Using the 2010 revised version of the Dutch physiotherapy practice guideline for hip and knee OA (http://www.fysionet-evidencebased.nl/index.php/kngf-guidelines-in-english)[15] as an example, the aim of the present study was to develop and compare two educational courses, i.e. an interactive course and a conventional presentation, with respect to their ability to improve satisfaction, knowledge and guideline adherence.

Methods

Study design

The study concerned a randomized controlled trial comparing two different educational courses for implementing the Dutch physiotherapy guideline for hip and knee OA[15] among PTs. A paper summary of the guideline was disseminated by regular mail among the members of the Royal Dutch Society for Physiotherapy [Koninklijk Nederlands Genootschap voor Fysiotherapie (KNGF)] in April 2010 and the complete guideline was made available on the Internet in June 2010 (http://www.fysionet-evidencebased.nl/index.php/kngf-guidelines-in-english).
Given the proven benefits of education, presentations on newly developed or updated guidelines are currently being organized by regional subdivisions of the KNGF in The Netherlands. These subdivisions organize educational courses for PTs on a monthly basis, and are, on average, attended by 10% of the members.

The study was performed in three regions in The Netherlands, from September 2010 to February 2011, and conducted in accordance with the Good Clinical Practices protocol and Declaration of Helsinki principles (http://www.wma.net/en/30publications/10policies/b3/). According to Dutch law, formal approval from an ethics committee is not required for this kind of project. PTs gave their consent to participate in the study by e-mail. The execution of educational courses, processing and analyses of data were all performed by the principle investigator.

Recruitment of PTs

In three regions in The Netherlands (West (Amsterdam), North (Groningen) and South-East (Nuenen)), all PTs who were members of the KNGF and registered as working in primary or secondary care were invited to participate in the study via an online newsletter that they received by e-mail. In the invitation newsletter, the purpose and methods of the study and the general contents of the two educational courses were explained. The dates of the two courses were mentioned (same day of the week, 1 week in between), however it was not stated which type of course would be provided on which date. PTs were informed that they were eligible for the study if they (i) were available on both dates, (ii) were the only PT from one practice or institution participating in the project to prevent contamination and (iii) were willing to fill in a questionnaire at three different time points. If PTs were not willing to participate, they were asked to provide the reason(s) why. All the invited PTs had the possibility to respond by e-mail.

Randomization

The randomization was carried out by members of the regional staff of the three subdivisions of the KNGF who were not involved in the educational courses or the study. First, all participants were listed and numbered after checking for double subscriptions from the same practice or institute. Then, by means of a random digit generator, each PT's number was assigned the number 1 (the interactive workshop (IW) group) or 2 (the conventional education (CE) group). Subsequently the PT numbers and assigned interventions were connected to the PTs' personal data. In each region the CE was carried out on the first of the two assigned dates and the IW 1 week thereafter. The participating PTs were unaware of this assignment until the date of the training course was confirmed. Both educational courses were offered for free. The regional staff recoded the randomization codes 1 and 2 on the randomization list into A and B, with the principal investigator being unaware of which of the two interventions were related to A or B until the statistical analyses were finished.

Educational courses

The interventions comprised two educational courses that were developed by an expert PT, pilot-tested among 10 PTs and adapted according to their comments. The expert PT had >10 years of experience in treating patients with hip and knee OA, followed advanced training courses concerning OA and was experienced in teaching professionals.

IW

The same expert PT was guiding the IWs in all three regions. Each workshop was carried out with the help of three or four patients with hip and/or knee OA and three or four PT teachers. The teaching PTs were required to treat patients with hip and knee OA every week and be familiar with the revised guideline. They were working in the same region where the IW took place and received 1.5 h instructions about the content of the workshop. They learned how to guide the participants in the process of clinical reasoning, received oral and written instruction and had to study the content of the guideline thoroughly.

The workshop started with a short summary of guideline recommendations. Subsequently the participants were divided in subgroups of 8-10 PTs. The patient presented his or her complaints and their consequences for daily activities and participation. More information was gathered by interviewing. Within each subgroup decisions were made concerning initial assessment, treatment modalities and the measurement instrument to be used, based on clinical reasoning. PTs and patients taking part in the educational course could provide feedback concerning all the decisions made. During this process the expert PT was available to give additional feedback. In a plenary session, the IW ended with a discussion about a fictional case and questions concerning the content of the guideline. The IW workshop lasted three hours.

CE

The CE intervention was provided by the same expert PT in all three regions. It comprised a presentation about the guideline developmental process and the recommendations in the guideline. Two different cases were presented to the group (one patient with hip OA and one with knee OA) and their initial assessment, treatment and the evaluation of treatment by means of measurement instruments were described, all according to the guideline. The educational course lasted two hours.

Evaluation

The evaluation included online questionnaires among PTs participating in the educational courses. All participating PTs were sent a hyperlink to an electronic questionnaire by e-mail before the educational course (T0), immediately afterwards (T1) and 3 months thereafter (T2). Information was gathered concerning age, sex, work setting, years of physiotherapy experience, the number of patients with hip and/or knee OA treated during the last 3 months and previous participation in educational courses concerning arthritis. To obtain optimal responses for the second and third time points, two reminders were sent by e-mail after 3 and 5 weeks to those who did not respond. If the

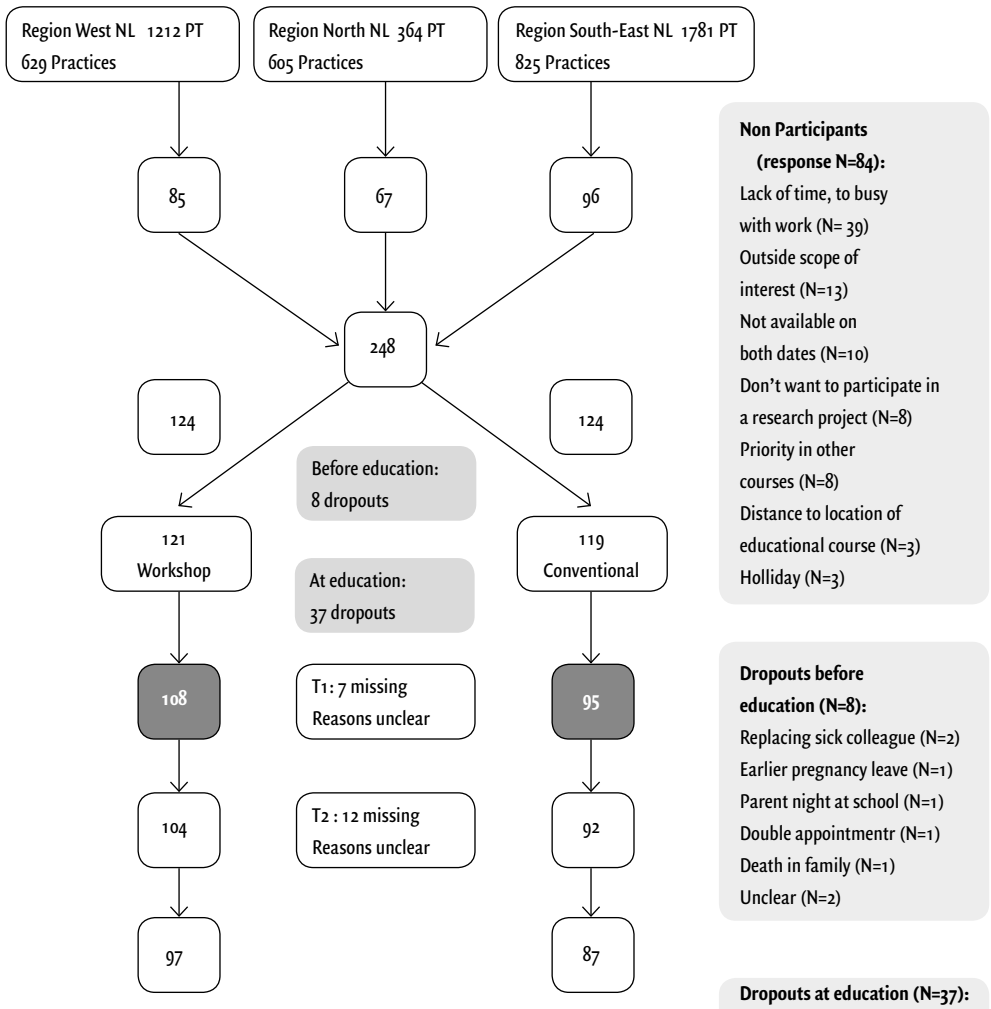


Figure 1. Recruitment and randomization

three required questionnaires were completed, the participant received accreditation from the KNGF for the educational course (four continuing education points).
The questionnaires consisted of measures of satisfaction with the educational course, knowledge on hip and knee OA and its treatment and self-reported adherence to the guideline. According to the Kirkpatrick model of training evaluation[16,17], which was applied to the evaluation retrospectively, these outcome measures address three of four levels of training evaluation. The four levels of Kirkpatrick's evaluation model essentially measure (i) reaction of students—what they thought and felt about the training; (ii) learning—the resulting increase in knowledge or capability; (iii) behaviour—extent of behaviour and capability improvement and implementation/application and (iv) results—the effects on the business or environment resulting from the trainee's performance. With the application of this model, the measurement of satisfaction is in accordance with the reaction level, the measurement of knowledge with the learning level and the measurement of self-reported adherence to the guideline with the behaviour level. Due to limited time and financial resources, the fourth results level could not be studied within the scope of the project.

Satisfaction

A self-developed satisfaction survey was administered once, directly after the course. It included three questions all rated on a point scale of 0-10 (higher score means more satisfaction): (i) How do you rate the content of the educational course? (ii) How do you rate the gained knowledge? (iii) How do you rate the applicability of the educational course to your daily practice?

Knowledge

Knowledge was measured using a self-developed knowledge questionnaire with 19 questions that were directly derived from the guideline. Ten items concerned theoretical knowledge (seven on initial assessment, one on treatment and two on evaluation). An example question was 'Which of the following items are specific red flags in patients with knee OA?' There were six answer options, of which two were correct. The other nine items concerned practical knowledge of recommended physiotherapy care in daily clinical practice (three on initial assessment, three on treatment and three on evaluation). For the question concerning treatment, a case was described and three possible treatment strategies were presented. The question was formulated as follows: 'Which of the following treatment strategies would be optimal?'—with only one of the strategies best fitting the recommendations in the guideline. The knowledge questionnaire comprised multiple choice and multiple response questions. In the case of a multiple choice question, a correct answer yielded 4 points. In a multiple response question, the score range depended on the number of correct answers: 4 points in the case of the maximum of three correct answers; 2 points in the case of two

correct answers; and 1 point for one correct answer. This yielded a total score range of 0-76, with a higher score indicating more knowledge.

Adherence

The participants were given a questionnaire concerning adherence to the recommendations in the updated KNGF guideline on hip and knee OA: Quality Indicators for Physiotherapy in Hip and Knee Osteoarthritis (QIP-HKOA).[18] This questionnaire contained 18 process indicators and was developed according to a similar procedure followed by Nijkrake et al.[19] in the evaluation of adherence to recommendations in the guideline for Parkinson's disease. The QIP-HKOA was found to have good face and content validity in a previous study among 185 PTs.[18] The 18 items were scored using a 5-point Likert scale: 0 = never; 1 = seldom; 2 = sometimes; 3 = generally; and 4 = always. The total score range was 0-72, with a higher score meaning greater adherence to recommendations.

Table 1. Baseline characteristics physiotherapists participating in Interactive Workshop (IW) and Conventional Education (CE)

	CE (N= 95)	IW (N=108)	P-value *
Age, years (mean, SD)	42.8 (12.8)	43.9 (11.1)	0.75
Gender, Females (%)	68 (71.6%)	74 (68,5%)	0.64
Work setting (%)			
Primary care	75 (78.9%)	85 (78.7%)	0.97
Hospital / rehabilitation centre / nursing home	20 (21.1%)	23 (21.3%)	
Experience (%)			
0-10 years	30 (31.6%)	34 (31.5%)	0.99
more than 10 years	66 (68.4%)	74 (68.5%)	
Number of OA patients treated last 3 months (%)			
0-10	87 (91.6%)	104 (96.3%)	0.16
more than 10	8 (8.4%)	4 (3.7%)	
Education in OA, yes (%)	23 (24.2%)	27 (25.0%)	0.90

*Students t-test or Chi-square test where appropriate

Table 2. Mean (change) scores and confidence intervals outcome measures for Interactive Workshop (IW) and Conventional Education (CE)

		Mean To (95% CI)	Mean T1 (95% CI)	Mean change To-T1 (95% CI)	Mean T2 (95% CI)	Mean change T1-T2 (95% CI)	P-value
QIP-HKOA (total score range 0-72)	**IW**	56.6 (55.4-57.8)	58.6 (57.3-59.8)	2.0 (1.1-2.9)	60.0 (58.7-61.3)	1.4 (0.6-2.2)	0.024*
	CE	55.6 (54.3-57.0)	56.3 (54.9-57.6)	0.7 (.-0.3-1.7)	57.2 (55.8-58.5)	0.9 (.-0.1-2.1)	
Knowledge questionnaire (total score range 0-76)	**IW**	42.2 (40.6-43.8)	47.2 (45.6-48.9)	5.0 (3.4-6.6)	46.5 (44.8-48.2)	.-0.7 (.-2.4-0.3)	0.278
	CE	41.3 (39.5-43.0)	45.7 (43.9-47.5)	4.4 (2.6-6.1)	43.7 (41.9-45.5)	.-2.0 (.-4.1-0.3)	

* Statistical significant difference over time according a linear mixed model analysis

Statistical analysis

Socio-demographic characteristics of the participants in the study are presented in Table 1. The baseline characteristics and PT satisfaction scores were compared between the two intervention groups by means of unpaired t-tests, Mann-Whitney U-tests or Chi-square tests, where appropriate.

A linear mixed model was employed to evaluate the effect of IW and CE on the improvement concerning guideline adherence and knowledge. The interaction between time and the nature of the educational course (i.e. IW and CE) was tested in order to examine changes of the effect over time. All data were analysed using the SPSS statistical package (version 18.0, SPSS, Chicago, IL, USA). The level of statistical significance was set at P = 0.05 for all analyses.

Results

Response and drop-outs

Fig. 1 shows the recruitment of PTs and randomization. In total, 4357 PTs working in 2059 primary practices or institutes in the three regions of The Netherlands were invited. Two hundred and forty-eight (12%) of them met the three predetermined criteria and subscribed to the study.

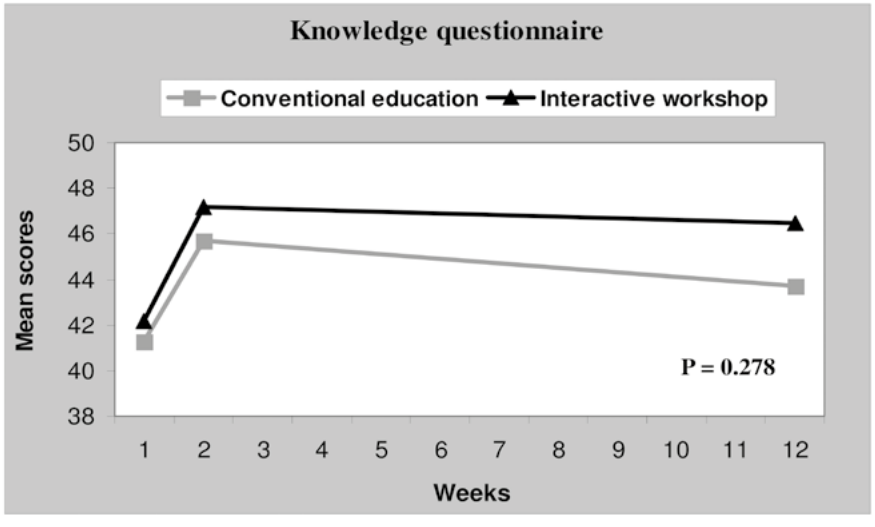
Forty-five of the 248 PTs did not show up at the educational course (16 in the workshop group and 29 in the conventional group) without giving notice. Of the remaining 203 PTs, 184 completed all the questionnaires at the three time points. The statistical analyses were performed using all the data available from 203 participants. Eighty-four PTs responded to the question of why they did not want to participate (Fig. 1).

Baseline characteristics of participating PTs

At baseline there were no differences in characteristics between PTs who attended the IW and PTs who attended the CE (Table 1).

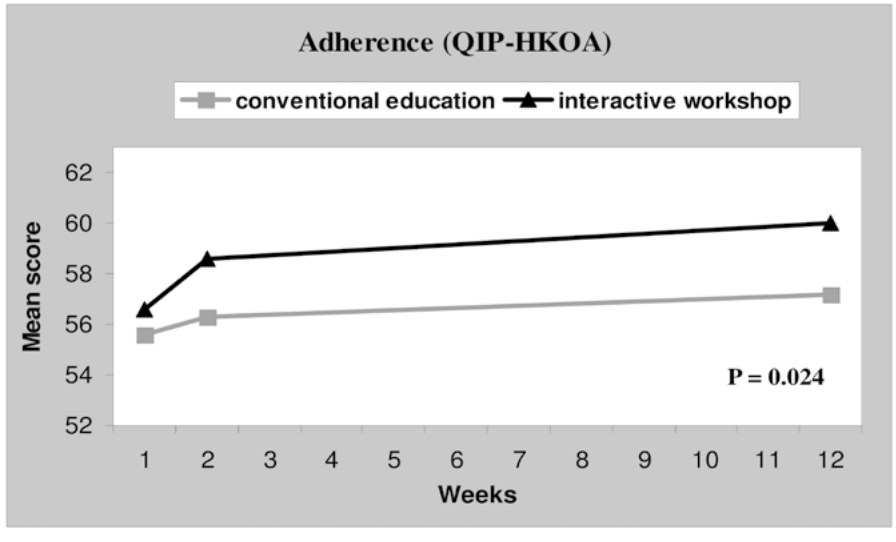
Satisfaction

With respect to PT satisfaction, the mean scores (total score range 0-10) were statistically and significantly higher in the IW group compared with the conventional group:



	Interactive workshop	Conventional education
Baseline	42.2	41.3
Immediatly after education	47.2	45.7
3 months after education	46.5	43.7

Figure 2. Mean score of knowledge questionnaire over time



	Interactive workshop	Conventional education
Baseline	56.6	55.6
Immediatly after education	58.6	56.3
3 months after education	60.0	57.2

Figure 3. Mean score of adherence questionnaire (QIP-HKOA) over time

increase in knowledge 7.1 (SD 1.4) vs 6.1 (SD 1.9), content of the educational course 7.4 (SD 1.0) vs 6.8 (SD 1.6) and expected applicability for daily clinical practice 7.9 (SD 0.8) vs 7.1 (SD 1.4), respectively (all P-values<0.005).

Knowledge

The mean knowledge score increased after the educational course at T1 in both groups, but decreased slightly between T1 and T2 (Table 2 and Fig. 2). Results from the linear mixed model showed a slightly greater change of the knowledge score in the IW group compared with the CE course group, with the difference persisting over time; however, the difference was not statistically significant (P = 0.278).

Adherence to process indicators (QIP-HKOA)

Table 2 and Fig. 3 show that in both groups the mean adherence score improved between baseline and directly after the educational course at T1, as well as between T1 and T2. Taking into account all time points, a statistically significantly greater improvement of the adherence score over time for the IW group compared with the CE course group was seen (P = 0.024).

Discussion

This study showed that an IW with the cooperation of patients and following a process of clinical reasoning was more effective with respect to satisfaction and with improving self-reported adherence to recommendations in a Dutch physiotherapy guideline on hip and knee OA than a CE course. No difference in increase of knowledge was seen between the two groups.

The results of the present study are in line with a similar randomized, controlled study on the implementation of the Dutch physiotherapy guideline for low back pain among 113 PTs. The study showed that after an interactive educational approach, PTs more often followed guideline recommendations than with dissemination alone.[14] Working according to the guideline implied that they limited the number of treatment sessions in patients with a normal course of back pain, set functional treatment goals, used mainly active interventions and gave adequate patient education.[14] Our results were also comparable with those of a randomized controlled study on the implementation of an Australian physiotherapy guideline concerning whiplash.[20] In that study, education including an interactive and practical session with problem solving followed by an educational visit after 6 months showed more effectiveness than guideline dissemination alone. Direct comparisons of magnitude effects seen in previous studies and the present one are difficult to make, as different outcome measures were used. In both previous studies, audits of PTs' records were used to determine the effect.

The significant effect seen in the present study is nevertheless remarkable, as the contrast between intervention and control was smaller than in the two previous studies. In both previous studies, PTs in the control group only received the guideline, whereas in the present study the control group received a control intervention consisting of a presentation about the developmental process and the content of the guideline. Moreover, in both previous studies the interactive interventions were more intensive than in the present study, as their duration was longer. In addition, the previous studies did not include patients as partners in the educational interventions. Patient participation was found to have a positive effect on medical student learning in several studies[21,22], and could have added value in improving physical examination skills.[23]

How an educational course should best be provided is also dependent on PTs' preferences. Greater satisfaction with an interactive approach as in the present study could improve participation in educational courses concerning guidelines and therefore probably increase adherence.

Regarding the evaluation of educational courses, there are various theoretical frameworks available.[16,17,24,25] Barr et al.[24] described a framework using the Kirkpatrick model as a basis, yet adding modifications of perceptions and attitudes to the learning level and changes in organizational practice and benefits to patients/clients to the results level. Moore et al.[25] proposed a model with six levels of educational outcomes, including participation, satisfaction, learning, performance, patient health and community health. Given the limited scope of the present study, the Kirkpatrick's model[16,17] matched the outcome measures best.

This study has a number of limitations. First, only 10% of potentially eligible PTs participated in the study, so selection bias cannot be excluded. Therefore the results cannot be generalized to PTs who did not participate in this study. Apart from a limited number of responses from non-participants, it is largely unknown which barriers played a role in deciding whether or not to take part in the study, such as lack of time or interest, and preference for other modes of delivery, such as online courses. With respect to alternative modes of delivery such as online courses or gaming, more research is needed. In a comparative evaluation of teaching methods for physiotherapy students by Willet et al.[26] it was found that lecture-based instruction was more effective than computer-based instruction, but with the latter the students spent less time studying. In general, more research on implementation strategies trying to reach PTs who do not participate in educational courses on guidelines is needed. A limitation concerning the intervention was that one expert PT was involved in both forms of education, so that a spill-over effect cannot be totally excluded. Moreover, the duration of the two interventions was not exactly the same. In addition, the use of different PT teachers and patients and the different locations could have led to bias, despite the use of a strict protocol and extensive
preparation. With respect to the evaluation, all the questionnaires were self-developed and were only to a limited extent tested regarding their clinimetric properties. Another limitation concerning the evaluation was the omission of the fourth level of the Kirkpatrick model of training evaluation, concerning the effect at the level of the PT's workplace and organization. To measure that effect a longer time frame would have been needed that would also have allowed determination of long-term effects regarding knowledge retention and guideline adherence. In addition, this would have required additional evaluations, such as measurement of the actual performance of PTs by chart review, measurement of outcomes at patient level or measurement of organizational changes at the PTs' practice level. Finally, although blinded for group assignment during the analyses and supervision of all analyses by a statistician, the principal investigator conducted both interventions and analyses.

Apart from all the above-mentioned limitations, it should be noted that education is only one possible strategy as part of the total implementation of guidelines, and, moreover, the focus of this study was only at the professional level. As indicated by Grol and Grimshaw[8], problems in implementation can arise at different levels in the health care system: at the level of the patient, the individual professional, the health care team, the health care organization or the wider environment. Other implementation strategies targeted at those levels could have had an additional effect.

In conclusion, an IW with the cooperation of patients and following a process of clinical reasoning was found to be more effective in the implementation of a physiotherapy guideline than CE. The results of the present study indicate that an interactive approach is a promising educational strategy to enhance the uptake of PT guidelines. To roll out an IW on a larger scale, a number of aspects need to be considered. First, patients and tutors are needed, requiring resources for their recruitment and training as well as payment for their activities in the course. Secondly, the relatively long duration of the course (3 h) increases the costs of renting a course venue and of catering. To compensate for the costs, the institution of a fee for attending PTs could be considered. We estimate that this fee would be relatively low, and therefore not likely to have a negative impact on the number of physical therapists willing to take part in the educational course. Implementation on a larger scale should be evaluated systematically, with respect to both the participation of PTs and its impact on the practice setting, patients and community. With these considerations taken into account, the authors would recommend the interactive educational approach be used by others as part of their implementation strategy concerning guidelines.

Rheumatology key message

Interactive education is an effective strategy for implementing a Dutch physiotherapy guideline in OA.

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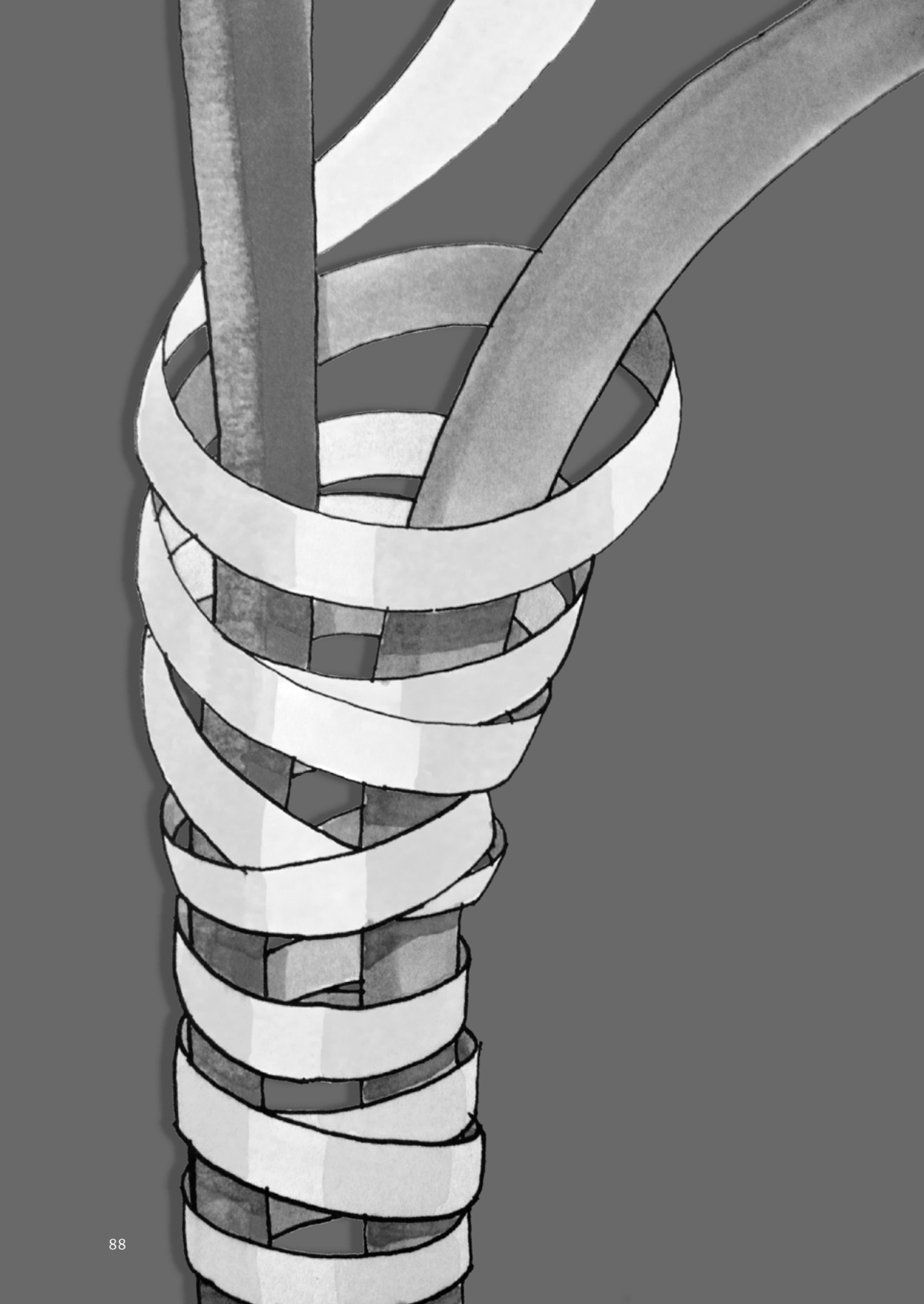

Chapter 5

Effectiveness of an interactive postgraduate educational intervention with patient participation on the adherence to a physiotherapy guideline for hip and knee osteoarthritis: *a randomised controlled trial*

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Abstract

Purpose: To determine the effectiveness of an interactive educational intervention on a physiotherapy guideline for hip and knee osteoarthritis.

Method: Physiotherapists were randomly allocated to a 3-hour interactive educational course with the collaboration of 3 patient partners or no intervention.
Assessments comprised questionnaires on adherence (score range 0-24), knowledge (score range 0-76), and barriers to use the guideline (score range 0-80). Assessments were conducted 1 week before the interactive course (T0) immediately after (T1), and 3 months thereafter (T2). Change scores were compared between the groups by means of Mann-Whitney U tests and linear mixed models.

Results: 284 of 4328 eligible PTs (7%) were included. The intervention (n=133) was significantly more effective than no intervention (n=151) concerning self-reported adherence and knowledge with mean differences in change scores (95% CI) at T1 and T2 being 1.4 (0.7-2.0) and 0.9 (0.2-1.7) for adherence and 6.8 (4.5-9.1) and 3.9 (1.7-6.2) for knowledge, (all p-values <0.005). In both groups the barrier score increased at T1 and decreased at T2, with a significantly larger increase at T1 and decrease at T2 in the intervention group (mean differences 3.1 (1.8-4.4) and 3.3 (0.5-6.1), respectively.

Conclusions: A short interactive educational course with patient participation on a PT guideline on hip and knee osteoarthritis showed a small to moderate positive effect on self-reported guideline adherence and knowledge, whereas for perceived barriers an advantage was only seen on the longer term.

Introduction

It is generally acknowledged that the introduction of evidence based guidelines and recommendations improve the quality of care.[1] However, adherence of health care providers to clinical guidelines is often unsatisfactory[1-3], so that the use of active implementation strategies, is recommended.[1-4] The institution of professional education specifically aimed at the use of guidelines is an example of such an active implementation strategy.
A systematic review on the effect of educational programs to implement clinical practice guidelines for osteoarthritis (OA) and rheumatoid arthritis (RA) in primary care[5] showed that in some of the available studies a decrease in the number of referrals to orthopaedics[6], improvement of the prescription of analgesics[7], or an increase in referrals to rehabilitation services[8] was found. One of these educational programs concerned an interactive, multidisciplinary educational intervention to implement best practices for OA and RA management.[8] It was recently evaluated among a larger group of professionals, with the conclusion of that study being that best practice scores improved significantly.[9] So far, little is known about the effectiveness of interactive educational interventions for the implementation of clinical practice guidelines for OA management specifically in physiotherapy. Earlier research on interactive postgraduate education for physiotherapy guidelines on low back pain and whiplash showed that such an intervention was effective with respect to guideline adherence.[10,11] In addition, in a randomized pilot study performed by our own group, an interactive, postgraduate educational course on an updated version of the Dutch physiotherapy guideline on hip and knee OA[12] was found to be more effective in improving guideline adherence and knowledge than conventional education solely consisting of a lecture on the guideline and its recommendations.[13]
In contrast with all of the abovementioned educational interventions the latter educational course included the involvement of patients, as patient participation has been found to have a positive effect on student learning in several studies.[7,14,15]
Given the promising results regarding the effectiveness of interactive, postgraduate education with the collaboration of patient partners to enhance the uptake of the physiotherapy guideline for the management of hip and knee OA, a larger study was considered timely. The aim of the present study was therefore to determine, on the national level, the effectiveness of such an educational intervention.

Methods

Study design

The study concerned a randomized, controlled trial comparing the effectiveness of an interactive, postgraduate educational course with a waiting list condition (implying provision of the workshop 4 months later). In line with the conduct of similar studies on

medical education by our group[13,16] the Medical Ethics Committee of the Leiden University Medical Center declared that this study was outside the remit of the Dutch law on medical research with human subjects (Wet op Medisch-Wetenschappelijk Onderzoek met mensen) and gave a written confirmation that no medical ethical approval nor written informed consent from participants was needed for this kind of study. The study was performed from May 2011 to January 2012 and conducted in accordance with the Handbook for Good Clinical Research Practice of the World Health Organization, and Declaration of Helsinki principles (http://www.wma.net/en/30publications/10policies/b3/). The principle investigator (WFP) was responsible for processing and analysing the data and was blinded for group assignment.

Recruitment of physiotherapists

The study was conducted across 6 national subdivisions of the Royal Dutch Society for Physiotherapy (KNGF) in the Netherlands (Amsterdam, Utrecht, Gelderland, Overijssel North and South, and Limburg), which all organize educational courses on a monthly basis. These courses are, on average, attended by 10% of the members according registration of the subdivisions of the KNGF. All physiotherapists who were a member of the national society and registered as working in primary or secondary care were invited to participate in the study via an e-mail newsletter. The invitation explained the purpose and methods of the study, the general contents of the interactive educational course and mentioned the dates the courses would be offered (four months' time in between courses). Physiotherapists were informed that they were eligible for the study if (a) they were available at both dates; (b) were the only physiotherapist from one practice or institution to participate (to prevent contamination); and (c) were willing to fill in questionnaires at three different time points. If physiotherapists were not willing to participate they were asked to provide the reason(s) why. Participants were ensured that if they participated, their data would be stored and analysed anonymously. They were also given the assurance that they were free to discontinue their participation at any time point during the study.

Characteristics of the physiotherapists

The following characteristics were gathered at the first assessment: age, sex, work setting (primary or secondary care), years of work experience as physiotherapist, the number of patients with hip and or knee OA treated during the last three months (less or more than 10), and previous participation in educational courses concerning rheumatic and musculoskeletal conditions (yes/no).

Randomization

The randomization was carried out by members of the regional staff of the 6 participating subdivisions who were not involved in the courses or the study, to ensure blindness of the researchers for allocation. First all members of the subdivisions were listed and numbered. Then, by means of a random digit generator, each physiotherapists' number was assigned the number 1 (interactive educational course) or 2 (waiting list group). Subsequently, the physiotherapist numbers and assigned interventions were connected to the physiotherapists' names and addresses. The participating physiotherapists were then informed to which date they were assigned. All physiotherapists had access to the guideline through the website of the national society and had received a printed summary of the guideline, as part of the usual, passive dissemination strategy.

Intervention

The interactive, educational course was developed and evaluated in a previous pilot study.[13] The course was guided by an expert physiotherapist, in cooperation with 3-4 patients and 3-4 physiotherapy teachers, who were instructed concerning their role during the course (see Appendix 1). A process of clinical reasoning was followed within the educational course according the Hypothesis-Oriented Algorithm for Clinicians (HOAC) II principles.[17] The course lasted three hours and was offered free of charge.

Control group

The control group received the same educational course four months after the first course in every region.

Outcome Measures

After randomization, all participating physiotherapists received a hyperlink to an electronic questionnaire by e-mail one week before the first interactive, educational course (T0), immediately after the course (T1), and three months thereafter (T2). In addition, a satisfaction questionnaire was sent to the intervention group at T1 and to the control group after 4 months. At T1 and T2 two reminders were sent by e-mail (after three and five weeks) to those who did not respond. In both groups the participants received accreditation from the national professional organization for the educational course (4 Continuing Education points), provided after they had attended the educational course and completed all questionnaires.

Measures of effectiveness

The primary outcome was self-reported adherence with the recommendations in the guideline, while knowledge about the contents of the guideline and perceived barriers in using the guideline were the secondary outcomes. The questionnaire to assess the effect of the intervention consisted of three parts: self-reported adherence, knowledge, and perceived barriers to use the guideline. Additionally, participants were asked to score their satisfaction with the course after completing it.

These outcome measures address the first three of four levels of training evaluation according to Kirkpatrick's evaluation model for education[18,19], which includes (1) reaction

of students – what they thought and felt about the training; (2) learning – the resulting increase in knowledge or capability; (3) behaviour – extent of behaviour and capability improvement and implementation/application; (4) results – the effects on the business or environment resulting from the trainee's performance. Due to limited time and financial resources, the fourth 'results' level could not be studied within the scope of the project.

Adherence with the guideline

Self-reported adherence was measured using the 6 items that were found to discriminate between expert and general physiotherapists in an 18-item questionnaire developed in a previous study.[20] The 6 selected items were: 1. Do you make an inventory of health related problems according the International Classification of Functioning, disability and health (ICF)?; 2. Do you assess the presence of hip and knee osteoarthritis-specific red flags?; 3. Do you evaluate the outcome of treatment with measurement instruments which are recommended in the guideline?; 4. Do you evaluate the outcome of treatment with a combination of a questionnaire and a performance based test?; 5. Do you evaluate the outcome of treatment with the Patient Specific Complaint list?; 6. Do you evaluate the outcome of treatment with the Timed Up and Go test? The score range of each question was 0-4 (0=never to 4 =always), yielding a total score range of the self-reported adherence questionnaire of 0-24, with a higher score meaning greater adherence.

Knowledge

Knowledge on the contents of the guideline was measured by means of a self-developed knowledge questionnaire[20], with 19 items reflecting the content of the guideline recommendations. The score range of each question was 0-4, yielding a total score range of 0-76, with a higher score meaning greater knowledge. As there was only one week between the first two assessments a learning effect was anticipated. Therefore, two versions were developed, using the same constructs and addressing similar topics from the guideline. These versions were pilot-tested among 15 physiotherapists, with no statistically significantly different scores between them (mean scores 54.2 (SD 8.1) and 53.9 (SD 7.3) (p=0.86, paired t-test)), with Pearson's correlation coefficient being 0.78 (p=0.001). Version A was used at T0 and T2, version B at T1.

Barriers for using the guideline

Barriers for using the guideline were measured by a self-developed questionnaire, based on a questionnaire developed to identify perceived barriers for implementing the Dutch physiotherapy COPD clinical practice guideline.[21] The questionnaire comprised 20 items on barriers in using the guideline (see Appendix 2), divided over 5 different dimensions: Design, Content and Feasibility (7 items); Change in working method (2 items); Knowledge and Skills (4 items); Applicability (4 items); Social environment

(3 items). Each item was scored on a 5-point Likert scale, ranging from 0 = totally agree to 4 = totally disagree. The total score range was 0-80. For items 5, 8-15, and 18-20 the reversed scores were used, in order to achieve a total score in which a higher score means more perceived barriers in using the guideline.

Satisfaction

A self-developed satisfaction survey was administered directly after the educational course in both groups and included 3 questions, all rated on a 0-10 point scale (higher score means more satisfaction): 1."How do you rate the content of the educational course?"; 2. "How do you rate the gained knowledge?"; and 3. "How do you rate the applicability of the educational course to your daily practice?"[13]

Data analysis

Baseline characteristics of the physiotherapists in the intervention and control groups were compared by means of Mann-Whitney U tests or Chi-Square tests, where appropriate.

Mean changes from baseline of the self-reported adherence, knowledge and barriers questionnaire scores within the two groups at T1 and T2 were computed with 95% confidence interval, with their statistical significance being tested with the Wilcoxon signed rank test. Differences of these change scores between the groups were compared by means of the Mann-Whitney U test.

In addition, an intention-to-treat analysis using all available data and time points was employed by means of a linear mixed model.[22] The difference between the groups over time of each of the three outcome measures (adherence, knowledge and barriers), was defined as the interaction between time and the nature of group assignment (intervention or control), with the analysis for each outcome measure being adjusted for the other two outcome measures.

For the barriers questionnaire, all within and between group analyses were repeated for each of the 5 dimensions separately, with adjustments in the linear mixed model being made for the total adherence and knowledge scores.

Finally, the Mann-Whitney U test was used to compare the satisfaction scores of physiotherapists who took part in the initial educational course (intervention group) or in the same course organized after the RCT was completed (control group).

The level of statistical significance was set at p = 0.05 for all analyses.

The power calculation was based on the previous pilot study, demonstrating an improvement of the score of the 6 items of the adherence questionnaire (theoretical score range 0-24) from 15 (SD 7) to 18 in the interactive educational intervention group.[20] Assuming no improvement in the control group, an alpha of 0.05 and a power of 0.80, 87 participants per group were considered necessary to detect a difference of 3 points. Taking in account a drop out of 20%[12], a minimum of 109 physiotherapists per group would be needed.

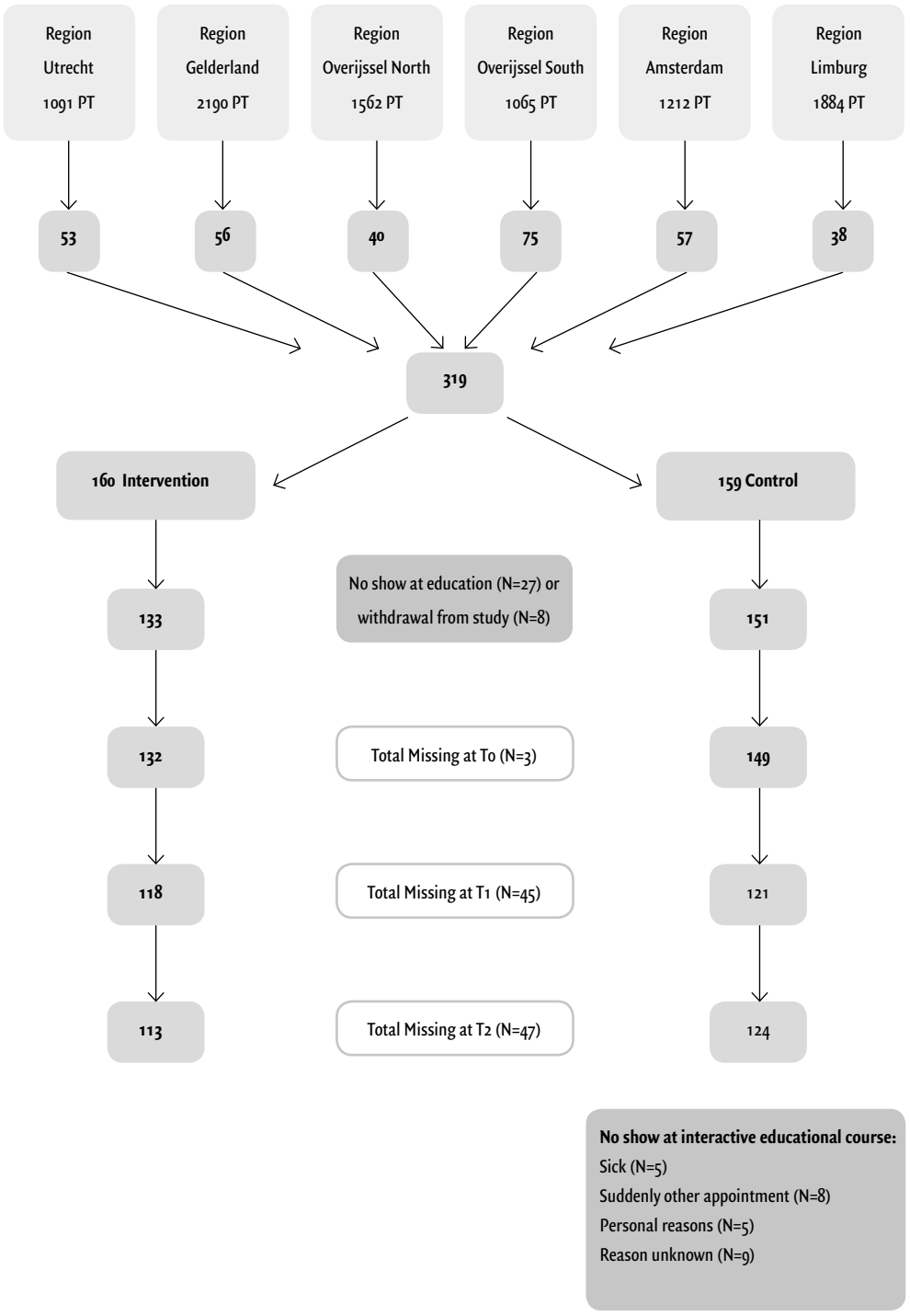

Figure 1. Recruitment and randomization of physiotherapists

Results

Response and dropouts

Figure 1 shows the recruitment and randomization of physiotherapists. In total, 9004 physiotherapists working in 4328 primary practices or institutes in the six regions were invited. As only one physiotherapist per practice could participate, in total 4328 physiotherapists were eligible to participate. Three-hundred and nineteen of them (7.4% of 4328) met the inclusion criteria and subscribed to the study.

Twenty-seven of the 319 physiotherapists did not show up at the first educational course, while 8 physiotherapists of the control group withdrew from the study before filling in any questionnaire. Of the remaining 284 physiotherapists who filled in the first questionnaire, 237 (83%) completed both two other assessments. Ninety-nine physiotherapists responded to the question why they did not want to participate. Main reasons were lack of time and not being available on both dates (figure 1).

Baseline characteristics of participating physiotherapists

Baseline sociodemographic characteristics of the participants are shown in table 1, with no statistically significant differences between the groups (results not shown).

Self-reported adherence with process indicators

Table 2 shows that compared to baseline the mean adherence score in both groups improved directly after the educational course at T1 and 3 months thereafter. The improvements at T1 and T2 in the intervention group (both p-values <0.001) and at T2

Table 1 Baseline characteristics of 284 physiotherapists participating in a randomized comparison of an interactive educational intervention on a practice guideline for hip and knee osteoarthritis and a waiting list condition

	Interactive educational intervention group (N=133)	Control group (N=151)
Age, years (mean, SD)	45.7 (10.6)	45.4 (11.9)
Gender, Males (%)	83 (62.4%)	90 (59.6%)
Worksetting		
primary care	102 (76.7%)	124 (82.1%)
hosptial/ rehabilitation center/ nursing home	31 (23.3%)	27 (17.9%)
Experience		
0-10 years	27 (20.3%)	41 (27.1%)
more than 10 years	106 (79.7%)	110 (72.9%)
Number of patients with hip and knee osteoarthritis treated past three months		
0-10	124 (93.2%)	142 (94.0%)
more than 10	7 (6.8%)	9 (6.0%)
Training in OA, yes (%)	35 (26.3%)	46 (30.5%)

Table 2. Mean (change) scores of outcome measures for 284 physiotherapists participating in a randomized comparison of an interactive educational intervention on a practice guideline for hip and knee osteoarthritis and a waiting list condition.

Unadjusted analyses		**Mean score To (SD)**	**Mean score T1 (SD)**	**Mean change To-T1 within groups (95% CI)**	**Mean difference between groups T1 (95% CI)**	**P-value**	**Mean score T2 (SD)**	**Mean change To-T2 within groups (95% CI)**	**Mean difference between groups T2 (95% CI)**	**P-value**	**Overall P-value**
Adherence questionnaire (total score range 0-24)	Intervention	14.4 (4.3)	16.0 (3.9)	1.7 (1.2-2.2)[1]	1.4 (0.7-2.0)	<0.001[2]	16.7 (3.9)	2.2 (1.7-2.7)[1]	0.9 (0.2-1.7)	0.004[2]	
	Control	14.5 (4.3)	14.5 (4.2)	0.3 (-0.1-0.8)			15.8 (4.1)	1.3 (0.7-1.9)[1]			
Knowledge questionnaire (total score range 0-76)	Intervention	42.8 (8.7)	50.0 (8.2)	6.9 (5.3-8.5)[1]	6.8 (4.5-9.1)	<0.001[2]	48.5 (7.7)	5.3 (3.7-6.9)[1]	3.9 (1.7-6.2)	0.004[2]	
	Control	40.9 (8.6)	41.4 (10.4)	0.1 (-1.6-1.7)			42.7 (9.2)	1.4 (0.3-3.0)			
Barriers questionnaire (total score range 0-80)	Intervention	48.3 (6.3)	51.9 (6.3)	3.6 (2.7-4.5)[1]	3.1 (1.8-4.4)	<0.001[2]	41.2 (5.6)	-7.4 (-9.2--5.6)[1]	3.3 (0.5-6.1)	0.010[2]	
	Control	45.8 (7.6)	46.4 (6.8)	0.5 (-0.4-1.4)			42.3 (6.1)	-4.1 (-6.2--2.0)[1]			
Linear Mixed Model		Estimated Marginal Mean score To (95% CI)[3]	Estimated Marginal Mean score T1 (95% CI)[3]	Estimated Marginal Mean change To-T1 (95% CI)[3]			Estimated Marginal Mean score T2 (95% CI)[3]	Estimated Marginal Mean change T1-T2 (95% CI)[3]			
Adherence questionnaire (total score range 0-24)	Intervention	14.3 (13.6-15.0)	15.6 (14.9-16.3)	1.3 (0.4-3.6)			16.9 (16.1-17.6)	1.3 (-0.3-3.2)			0.006[3]
	Control	14.5 (13.8-15.2)	14.7 (14.0-15.4)	0.2 (-0.7-0.6)			16.1 (15.4-16.8)	1.4 (-1.9-4.8)			
Knowledge questionnaire (total score range 0-76)	Intervention	42.7 (41.2-44.2)	48.7 (47.1-50.3)	7.0 (5.3-8.5)			48.8 (47.1-50.4)	-1.5 (-3.0--0.1)			< 0.001[3]
	Control	41.1 (39.6-42.5)	41.2 (39.7-42.7)	0.1 (-1.6-1.7)			43.0 (41.5-44.6)	1.8 (-0.4-3.4)			
Barriers questionnaire (total score range 0-80)	Intervention	48.7 (47.6-49.8)	51.2 (50.0-52.4)	2.5 (2.1-4.5)			40.3 (40.0-42.4)	-10.9 (-12.0--9.0)			< 0.001[3]
	Control	46.5 (45.4-47.6)	47.0 (45.8-48.2)	0.5 (-0.4-1.4)			42.4 (41.2-43.6)	-4.6 (-6.1--2.0)			

1 = P<0.005 according a Wilcoxon signed rank test, 2 Mann-Whitney U test, 3 Linear Mixed Model

in the control group (p-value <0.001) reached statistical significance. The improvement was however statistically significantly greater in the intervention group than in the control group at both T1 and T2 (p-value <0.001 and 0.004, respectively).
When taking into account all time points with the linear mixed model, a statistically significant difference of the change in adherence score over time was seen in the intervention group as compared to the control group (p=0.006).

Knowledge

The mean knowledge score increased in both groups, with the improvement from baseline in the intervention group reaching statistical significance at both T1 and T2 (both p-values <0.001) (table 2). The difference in improvement was statistically significantly greater in the intervention group than in the control group at both T1 and T2 (p-value <0.001 and 0.004, respectively).
Over all time points, the linear mixed model showed a statistically greater improvement of the knowledge score in the intervention group compared to the control group (p<0.001).

Perceived barriers for using the guideline

The mean score of the 'Barriers for using the guideline questionnaire' increased significantly at T1 in the intervention group compared to baseline (p-value <0.001), whereas the increase in the control group did not reach statistical significance (p-value 0.213) (table 2). The difference between the change scores of the perceived barrier score reached statistical significance in favour of the control group at T1 (p-value <0.001) and in favour of the intervention group at T2 (p-value 0.010). Taking into account all time points, the difference between the changes of the perceived barrier scores was statistically significant (p<0.001) greater in favour of the intervention group.
Analyses of the 5 dimensions of the barriers questionnaire separately showed that the initial increase of perceived barriers was seen in both groups for all dimensions, with the increase being significantly greater at T1 in the intervention group for the dimensions Design, Content and Feasibility; and Knowledge and Skills (p-values 0.01 and < 0.001, respectively). At T2, the decrease was significantly greater in the intervention group than in the control group for the dimensions Change in working methods; and Knowledge and Skills (p-values 0.03 and 0.04, respectively) (Results not shown).

Satisfaction

One hundred fifteen (86%) and 120 (79%) physiotherapists completed the satisfaction questionnaire after the course in the intervention and control groups, respectively. Overall, the results were favourable and did not differ between the two groups (Increase in knowledge: 6.8 (SD 0.48) and 6.9 (SD 0.18); Content of the educational course: 7.5 (SD 0.23) and 7.4 (SD 0.31); and expected applicability for daily clinical practice: 7.3 (SD 0.33) and 7.4 (SD 0.46), respectively).

Discussion

This study showed that an interactive, postgraduate educational course with cooperation of patients and following a process of clinical reasoning was an effective intervention to enhance self-reported knowledge and usage regarding a Dutch physiotherapy guideline on hip and knee OA. An effect on perceived barriers was only seen on the longer term The overall satisfaction with the intervention was good.

The results of our study are in line with a systematic review on the effect of educational interventions to enhance implementation of practice guidelines for arthritis management in primary care[5], in particular with respect to the effectiveness of interactive workshops. Our results are best comparable to two Canadian studies on an interactive, multidisciplinary educational intervention to implement best practices for OA and RA management[8,9], of which the first was included in the review. In that study, an interactive, educational intervention had a positive effect on referrals to The Arthritis Society Therapy program, the provision of relevant information, health professionals' confidence in their examination skills and perceived barriers to rheumatology care. In a larger, observational study with the same intervention[9] it was found that best practice scores improved significantly, in particular among rehabilitation therapists, including physiotherapists. Compared to the present study, the Canadian intervention was more extensive in time (2 days and follow up sessions), multidisciplinary by nature and used more written materials and plans for implementing in daily practice than the current interactive course. Comparisons are also hampered by differences in evaluation methods and a longer follow-up (6 months) in both the Canadian studies.

The results of the present study are also in line with previous research on the effectiveness of interactive postgraduate education specifically in physiotherapy, yet in other conditions. Interactive, postgraduate education proved to be effective regarding adherence with physiotherapy guidelines on low back pain and whiplash.[10,11] In both studies, audits of physiotherapists' records were used to assess adherence, whereas in the present study questionnaires were used. The study from Rebbeck et al[11] also assessed the effect on knowledge, but neither of the previous studies evaluated perceived barriers in using the guideline.

Overall, in comparison with all of the abovementioned interactive educational interventions, the duration of the intervention used in the present study was shorter. It is therefore noteworthy that nevertheless a significant effect on self-reported adherence, knowledge and, on the longer term, on perceived barriers was seen. It remains unclear to what extent the positive effect can probably be attributed to the collaboration with patient partners. Patient participation was found to have a positive effect on medical student learning in several studies, and could have an added value for instance to improve physical examination skills.[7,14,15]

In general, the effect regarding the primary outcome self-reported adherence with recommendations in the guideline was significant, yet relatively small. This may be related to the short duration without any follow up session of the educational course. Another explanation could be related to the instrument to measure adherence. The six selected indicators[20] in that instrument cover only a selection of topics that were part of the educational course. It is noteworthy that some significant improvements were seen in the control group. It remains unclear to what extent the repeated completion of questionnaires contributed to this effect in the control group. Moreover, the effect of exposure to the disseminated guideline in daily practice was maybe underestimated, which made the contrast between groups smaller.

The increase of perceived barriers to the use of the guideline directly following the course in the intervention group seems counterintuitive and remains to be explained. It could probably be related to the fact that the time frame was too short to have assessed and treated patients with hip or knee OA, which made the physiotherapists feel less confident to actually apply the guideline recommendations in daily practice.

Regarding the evaluation of educational courses, there are various theoretical frameworks available.[18,19,23,24] Barr et al[23] described a framework using the Kirkpatrick model as basis, yet adding "Modifications of perceptions and attitudes" to the learning level, and "Change in organizational practice" and "Benefits to patients/clients" to the results level. Moore et al[24] proposed a model with 6 levels of educational outcomes, including participation, satisfaction, learning, performance, patient health and community health. Given the limited scope of the present study, the Kirkpatrick's model[18,19] matched the outcome measures best.

This study has a number of limitations. First, recruitment took place only among members of the regional organizations of physiotherapists, constituting about 80% of all members of the Royal Dutch Society of Physiotherapy (personal communication). Another potential source of selection bias could be that only 7% of potentially eligible physiotherapists participated in the study. The attendance rate was however only slightly lower than that of other non-compulsory educational courses for physiotherapists. This overall low participation rate could lead to the consideration of the professional organization to include educational courses on guidelines in the compulsory education for physiotherapists, of course with free choice from several guidelines on different diagnoses. Moreover, it indicates that research into alternative modes of delivery of postgraduate educational courses is needed. As lack of time and not being available at the specific dates on which the course was delivered were the most common reasons for non-participation, the development of online courses is an attractive alternative option. The observation that the compliance with the online questionnaires was very high in the present study substantiates the willingness of physiotherapists to participate in e-learning. However, it should be noted that with this

mode of delivery personal interaction with patients and teachers cannot be provided. Regarding the measurement instruments used, it is debatable whether process indicators are suitable enough to measure adherence to guideline recommendations. In addition, only the questionnaires to assess adherence and knowledge had been previously tested with respect to their validity[13,20], whereas the questionnaire on perceived barriers had not been used before. As the questionnaire on adherence was based on self-report, it cannot be ruled out that socially desired answers were given. Although measures of adherence based on self-report have been used in other studies[10,11] as well, data from (electronic) patient records and/or interviews could probably yield additional information. Ideally, information is gathered from different sources, so that actual change in behaviour can be measured, however this is time-consuming and costly, and was therefore not feasible within the context of the present study.

In conclusion, an interactive educational course with cooperation of patient partners seems to be an effective strategy to improve guideline adherence and knowledge but also, on the longer term, to decrease barriers to use the guideline in daily clinical practice.

Education for professionals is just one implementation strategy to improve adherence with guidelines. To further improve guideline adherence other implementation strategies, such as interventions focussing on change in behaviour of professionals, or strategies aiming at the level of the patient, the health care organization and/or social context, should be developed and evaluated.

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Appendix 1 Interactive postgraduate educational course for the implementing the Dutch physiotherapy practice guideline for hip and knee osteoarthritis

Interactive postgraduate educational course for implementing the Dutch physiotherapy practice guideline in hip and knee osteoarthritis

1.	Registration	60 min.
2.	Oral presentation regarding the content of the guideline	30 min.
3.	Workshop with the participation of patient partners using topics in the guideline	75 min.
4.	Break	15 min.
5.	Short oral presentation and practical session regarding functional exercises	30 min.
6.	Plenary discussion with two fictional cases and questions concerning the guideline	45 min.
7.	Evaluation and closing	15 min.
	Total	270 min.

Ad 1. Registration

Participants register for the course in order to receive 4 Continuous Educational points. They receive the course material containing the guideline, instructions for the workshop, measurement instruments information and handouts of the presentations regarding the guideline, functional exercises and the two fictional cases, and an evaluation form.

Ad 2. Oral presentation regarding the content of the guideline

The content of the guideline is presented by the first author of the guideline and expert in the treatment of patients with hip and knee osteoarthritis. Key aspects:

- Introduction, including comparisons with the former version of the guideline; what's new?
- Short overview regarding risk factors for the development and progression of the disease, and current state of the art regarding (multidisciplinary) treatment.
- Diagnostic Process: International Classification of Functioning, Disability and Health (ICF), red flags, measurement instruments; all linked to the recommendations in the guideline.
- Therapeutic Process: setting of Specific Measurable Acceptable Realistic Time lined (SMART) treatment goals, recommended treatment modalities.

Ad 3. Workshop with the participation of patient partners using topics in the guideline and following a process of clinical reasoning

3-4 Subgroups of 10-12 physiotherapists are formed.

Each subgroup is guided by a physiotherapist teacher. The expert physiotherapists are supervising all the groups.

Requirements for the physiotherapist teachers should be: to treat patients with hip and knee OA at least every week and being familiar with the revised guideline. They should work in the same region where the educational course takes place and receive one and a half hour instructions about the content of the workshop. They learn how to guide the participants in the process of clinical reasoning, receiving oral and written instruction and should study the content of the guideline thoroughly.

Each group is accompanied by a patient partner who presents his/her problems based on the hip or knee osteoarthritis.

The patient is invited by the physiotherapist teacher, who is treating the patient, if (s)he was willing to participate in the educational course. The patient is instructed about the content of the course and his or her role in the course. He or she is asked to fill in a questionnaire regarding physical functioning and specific limited activities due to the osteoarthritis.

The following steps are taken in the workshop:

1. The patients present themselves to the participating physiotherapists with their complaints.
2. Additional questions are asked by one of the physiotherapists to gather all the necessary information. It is important that information is gathered regarding red flags, risk factors and all the domains of the ICF.
3. The other physiotherapists give constructive feedback on the way information is gathered.

4. The group of physiotherapists decide which of the recommended questionnaires could be used to support the diagnostic process and select one of them.
5. One of the physiotherapists discusses the chosen questionnaire with the patient, who has filled in the questionnaire in advance.
6. Subsequently constructive feedback is given on the discussion.
7. Additional information is given by the physiotherapist teacher regarding the examination of the patient. Subsequently a recommended measurement instrument is chosen to support the findings in the examination.
8. Another physiotherapist uses the measurement instrument and discusses its results afterwards with the patient.
9. Constructive feedback is given to the way the measurement instrument is used and interpreted.
10. All findings are summarized by one physiotherapist and discussed with the patient. Subsequently treatment goals, treatment plan and strategy are discussed with the patient.
11. The final constructive feedback is given by the other physiotherapists in the group and the goals, plan and strategy is discussed with the group and the patient.

All the steps in the workshop are guided by the physiotherapist teacher and are carried out according a process of clinical reasoning. It is the responsibility of the physiotherapist teacher to watch over the following points of attention in order to create a situation in which good clinical reasoning can be performed:

- Point the feedback to the observed behaviour, not to the person.
- Give the feedback descriptively and do not judge.
- First give positive feedback, then points to improve.
- Do not repeat feedback that was already given by others.
- Be critical. Do not give 'tissue-feedback' as for instance: "Yes… you were very friendly and caring and you had a good contact with the patient".
- Be specific and clear and avoid generality.
- Dose your feedback, and be short and to the point.
- Watch non-verbal behaviour of the person you provide feedback and ask if the feedback is understood.
- Do not give feedback if you do not have any points of attention or if you are not prepared sufficiently. Be honest.

The physiotherapist teacher is also responsible for staying within the time limits. If during the workshop none of the physiotherapist volunteers for an active role, the physiotherapist teacher points out someone.

Ad 4. Coffee break

Ad 5. Short oral presentation and practical session regarding functional exercises

Examples of functional exercises are presented. For walking, stair climbing, and rising and sitting down, exercises are shown how to build up the execution and intensity of exercises to the final optimal performance of the activity. Subsequently the most important activities according to the patients are discussed and relevant exercises or other interventions are demonstrated.

Ad 6. Plenary discussion with two fictional cases and questions concerning the guideline

In this plenary session two fictional cases, one on hip and one on knee osteoarthritis, will be presented by the expert physiotherapist. In each case similar steps as in the workshop are taken. In between, questions are asked to the group. The questions are all directly related to the content of the recommendations in the guideline.

Ad 7. Evaluation and Closing

Finally all participants will be thanked for their active participation especially the patients partners. The physiotherapists are invited to fill in an evaluation form concerning the educational course and the organization.

Appendix 2 Questionnaire on barriers in using the Dutch physiotherapy guideline in hip and knee osteoarthritis

Questionnaire on barriers for using the Dutch physiotherapy guideline on hip and knee osteoarthritis

Design, Content and Feasibility

1. The guideline is applicable in daily clinical practice.
2. The guideline gives the opportunity to make your own decisions regarding initial assessment, treatment and evaluation.
3. The guideline gives the opportunity to work in a patient-centered way.
4. The guideline is supporting the improvement of my knowledge regarding hip and knee osteoarthritis.
5. Some contents of the guideline is incorrect.
6. The lay-out of the guideline facilitates its usage in daily clinical practice.
7. The recommendations in the guideline are clear and understandable.

Change in working method

8. In general I feel resistance towards working according to guidelines.
9. The guideline does not fit my working methods and my daily clinical practice.

Knowledge and Skills

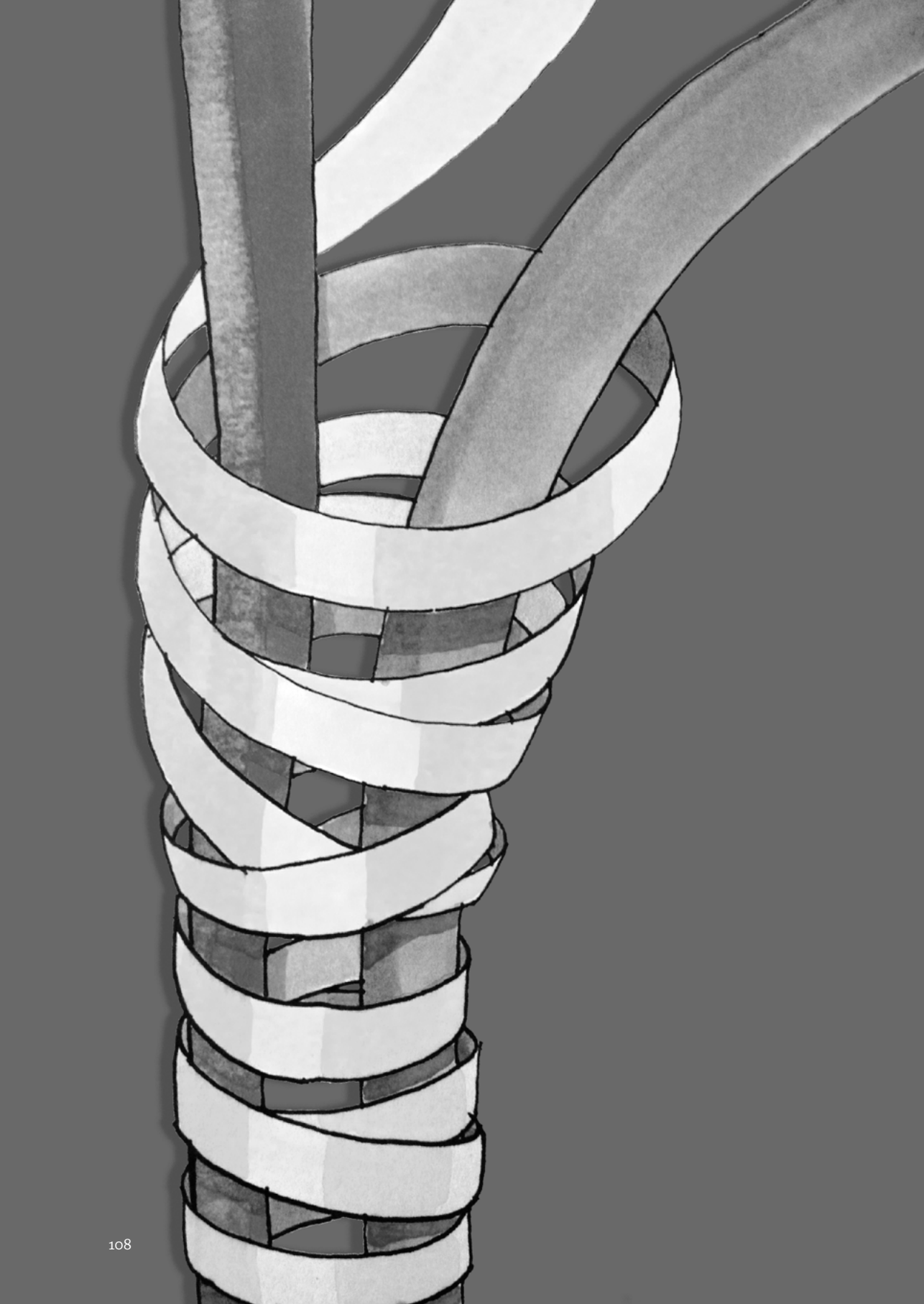
10. I would like to know more about the guideline before I decide to apply it in daily clinical practice.
11. I did not read the guideline sufficiently to remember any of its contents.
12. I am lacking the knowledge to apply the guideline in daily clinical practice.
13. I am lacking the skills to apply the guideline in daily clinical practice.

Applicability

14. Working according to the guideline is too time-consuming.
15. Working according to the guideline should be financially rewarded.
16. The guideline is applicable to patients with a lower social economic status.
17. The guideline is applicable to patients with a cultural background other than Dutch.

Social environment

18. My colleagues in physiotherapy are not cooperative in applying the guideline in daily clinical practice.
19. The management of my practice is not collaborative regarding the application of the guideline in daily clinical practice
20. The general practitioners with whom I work together are not collaborative regarding the application of the guideline in daily clinical practice.



Chapter 6

Guideline recommendations for post-acute postoperative physiotherapy in total hip and knee arthroplasty: *are they used in daily clinical practice?*

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Abstract

Background: In a Dutch guideline on physiotherapy (PT) in hip and knee osteoarthritis, a number of recommendations on post-acute (i.e. after discharge from hospital) PT following total hip (THA) and total knee (TKA) arthroplasty were included. Little is known about the uptake of these recommendations in daily clinical practice.

Objective: The aim of the present study was to determine the extent to which the guideline recommendations regarding post-acute PT after THA and TKA are followed in daily clinical practice.

Methods: An online pilot survey on the delivery of post-acute, postoperative PT was sent to a random sample of 957 Dutch physiotherapists. The survey included questions on the application of recommended, neither recommended nor advised against, and advised against treatment modalities and various treatment modalities for which there were no formulated recommendations.

Results: A total of 219 physiotherapists completed the questionnaire, with a mean age of 40 years (standard deviation 12.6), 55% female and 95% working in primary care. The vast majority reported the use of the recommended exercise modalities (muscle strengthening exercises (96%), and functional exercises (99%)). Continuous passive motion, which was neither recommended nor advised against, and electrical muscle stimulation, which was not recommended, were provided by 1%. Reported treatment modalities for which there were no formulated recommendations included patient education (99%), gait training (95%), active range of motion (ROM) exercises (93%), balance exercises (86%), passive ROM exercises (58%), aerobic exercises (50%), massage (18%) and cold therapy (11%).

Conclusions: The vast majority of physiotherapists reported adhering to recommendations on post-acute postoperative PT in THA and TKA patients after discharge from hospital. Although yet to be confirmed in a larger nationwide survey, the relatively high frequency of use of many other treatment modalities, for which there were no formulated recommendations, suggests the need to extend the current set of recommendations to include evidence-based statements on additional treatment modalities.

Introduction

Osteoarthritis is the most prevalent chronic joint disease[1,2], and the most common reason for total joint replacement in the Netherlands. By 2009, the numbers of patients undergoing total hip arthroplasty (THA) and total knee arthroplasty (TKA) had risen to 1.6 and 1.2 per 1000 per year, respectively, in Western countries.[3] Post-surgical rehabilitation is an integral part of the provision of THA and TKA[4], with physiotherapy (PT) being considered the gold standard to achieve functional independence and return to work and recreational activities.[5] A systematic review on PT exercise after THA suggests that exercises, given in the post-acute phase, after discharge from hospital, have the potential to benefit patients[6], whereas PT exercise after TKA was found to have a short-term, small to moderate effect on function, range of motion (ROM) and quality of life.[7] These overall beneficial effects were confirmed in two randomized controlled trials (RCTs)[8,9] published after the reviews.

So far, the evidence on post-acute postoperative PT in THA and TKA has not been fully incorporated into practice guidelines and recommendations.[10] The extent to which this lack of professional guidance plays a role in the observed, relatively large variation in the delivery, duration and intensity of PT care after THA and TKA remains to be established.[5,10–13] Regarding the nature of the postoperative PT used in THA and TKA, in a telephone survey among 24 orthopaedic centres in the UK, group therapy including strengthening and stretching exercises was most often reported.[14] Naylor et al.[13] concluded in a nationwide survey that there was considerable practice variation with respect to the modes of rehabilitation after TKA among physiotherapy departments in hospitals in Australia.

In the Netherlands, an update of a PT practice guideline on hip and knee osteoarthritis was developed in 2010.[15] The guideline was developed according to national and international methods for guideline development and implementation.[16] To evaluate the effect of each relevant PT intervention, a systematic review was conducted. Regarding post-acute PT after THA or TKA, muscle strengthening and functional exercises were recommended; continuous passive motion (CPM) after TKA was neither recommended nor advised against, and electrical stimulation was advised against.

The present study aimed to examine, from the perspective of the physiotherapist, the extent to which both of the treatment modalities included in the recommendations, as well as those which were not mentioned in the guideline, were applied in daily clinical practice. This knowledge may guide the possible need for implementation strategies for the current guideline recommendations, and may indicate areas where additional guideline recommendations are needed.

Methods

This cross-sectional pilot study comprised a survey among physiotherapists working in primary and secondary care in the south-western part of the Netherlands. The study was conducted in October–November 2012. As the study concerned a survey to be completed anonymously and once only, with no reminders being sent, it fell outside the remit of the Dutch law (Medical Research Involving Human Subjects Act; MO), and no review by the Medical Ethical Committee of the Leiden University Medical Center was needed. The study was conducted in accordance with the Handbook for Good Clinical Research Practice of the World Health Organization, and Declaration of Helsinki principles (http://www.wma.net/en/30publications/10policies/b3/).

Recruitment of physiotherapists

A random selection of 1,000 physiotherapists was made out of 3,000 members of a subdivision of the Royal Dutch Society of Physiotherapy (Koninklijk Nederlands Genootschap voor Fysiotherapie; KNGF) in the south- western part of the Netherlands and registered in the quality register of the national society. In total, there are 20,000 physiotherapists in the Netherlands who are registered as such. The selection for the present pilot survey was made by a member of the national society who was not involved in the study. The south-western part of the Netherlands was chosen because an earlier study regarding the use of PT in THA and TKA from the patient perspective had been carried out in the same region. Selected physiotherapists were sent an invitation by email to complete a single questionnaire regarding PT treatment after THA and TKA. They were assured that if they participated, their data would be anonymized. No reminders were sent.

Survey of the PT provision

The survey was provided by means of NetQuestionnaire software (NetQuestionnaire®, Utrecht, the Netherlands). The participating physiotherapists were sent an email with a link to the questionnaire.

The physiotherapists were first asked about their characteristics: age, gender, work setting (private practice, primary care health centre, hospital, rehabilitation centre or nursing home), work experience (in general and specifically, with respect to the treatment of patients undergoing THA or TKA: 0–5 years, 6–10 years, 11–15 years, 16–20 years, more than 20 years), number of new THA and/or TKA patients treated in the previous six months (0–5, 6–10, 11–15, more than 15) and if they had taken part in any postgraduate education regarding the management of THA and TKA patients (yes/no). Subsequently, they were asked who made referrals to them (orthopaedic surgeon, general practitioner or patient self-referrals, without the involvement of a physician; more than one answer was possible); the frequency with which they saw each patient (once a week, twice a week, three times a week or more); the estimated average duration of each session (two, four, six, 8–12 weeks, more than 12 weeks); the mode of delivery (individual, group therapy, aquatic therapy; further answers could be added).

Questions were then asked about the provision of specific PT treatment modalities (yes/no):

1. Recommended treatment modalities (muscle strengthening exercises and functional exercises, the latter divided into individualized physical activities);
2. Treatment modalities which were neither recommended nor advised against (CPM after TKA);
3. Treatment modalities which were not recommended (physical modalities other than massage, heat and cold therapy, including electrical stimulation);
4. Treatment modalities which were not included in the guideline (active ROM exercises, aerobic exercises, gait training, balance exercises, massage, heat and cold therapy, passive ROM exercises and patient education).

Statistical analyses

Descriptive statistics were used for the characteristics of the physiotherapists and the provided PT treatment. Data were analysed using the SPSS statistical package (version 20.0, SPSS, Chicago, IL, USA).

Results

In total, 1,000 emails were sent to the 1,000 selected physiotherapists, of whom 43 were returned immediately because the email addresses were incorrect. Of the remaining 957, 31 responded that they were not eligible to participate as they were not treating THA or TKA patients after surgery. In total, 219 physiotherapists completed the questionnaire.

Characteristics of the physiotherapists

Table 1 shows the characteristics of the 219 physiotherapists participating in the study. The mean age was 40.4 (standard deviation 12.6) years, 120 (55%) were female, 208 (95%) were working in primary care, 134 (57%) had over ten years of work experience as a physiotherapist and 114 (52%) had more than ten years of experience in working with THA and TKA patients. Ninety-five (44%) had seen more than five THA and TKA patients in the previous six months, 62 (28%) had undertaken postgraduate education in perioperative PT in joint replacement surgery. Referrals were most often made by the orthopaedic surgeon (n = 214; 98%). The vast majority of physiotherapists (n = 180; 83%) indicated that the average frequency was twice a week with which they saw patients, with 141 (65%) reporting that the average duration of treatment was more than 12 weeks. Almost all of them treated patients individually and 54 (25%) provided additional group therapy.

Table 1 Characteristics of 219 physiotherapists treating patients after Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA)

Age, years, mean (SD)	40.4 (12.6)
Sex, female (%)	120 (54.8%)
Worksetting	
primary care	208 (95.0%)
secondary care	11 (5.0%)
Work experience	
0-5 years	63 (28.8%)
6-10 years	32 (14.6%)
11-15 years	21 (9.6%)
16-20 years	20 (9.1%)
more than 20 years	83 (37.9%)
Work experience with treatment of THA and TKA patients	
0-5 years	65 (29.7%)
6-10 years	40 (18.3%)
11-15 years	23 (10.5%)
16-20 years	26 (11.9%)
more than 20 years	65 (29.6%)
Number of new THA and TKA patients past 6 months	
0-5 patients	124 (56.7%)
6-10 patients	74 (33.8%)
11-15 patients	15 (6.8%)
more than 15 patients	6 (2.7%)
Completed postgraduate education regarding peripostoperative physiotherapy in joint replacement surgery	62 (28.3%)
Referral (more than one possible answer)	
Orthopedic surgeon	214 (97.7%)
General practicioner	19 (8.7%)
Direct acces to physiotherapy without referral	20 (9.1%)
Average frequency	(N=217)
Once per week	33 (15.2%)
Twice per week	180 (83.0%)
3 times per week or more	4 (1.8%)
Duration	(N=216)
2 weeks	0
4 weeks	3 (1.4%)
6 weeks	19 (8.8%)
8-12 weeks	53 (24.5%)
More than 12 weeks	141 (65.3%)
Mode of delivery (more than one possible answer)	
Individual	218 (99.5%)
Group therapy	54 (24.7%)
Aquatic therapy	4 (1.8%)

Postoperative physiotherapy

Table 2 shows the reported frequencies of treatment modalities which were either recommended, not recommended or advised against, advised against, or not mentioned in the guideline. A total of 210 physiotherapists (96%) reported providing muscle strengthening exercises, whereas 218 (99%) indicated the use of at least one type of functional exercise from the list provided.

The numbers (%) of physiotherapists reporting the use of specific functional exercises were: walking stairs (n = 207; 95%); getting up and sitting down (n = 198; 90%); walking exercises outdoors (n = 187; 85%); cycling outdoors (n = 87, 40%); and other individualized functional activities (n = 125; 57%).

Physical treatment modalities (e.g. CPM, which was neither recommended nor advised against, and electrical muscle stimulation, which was advised against) were reported by three respondents (1.4%). The numbers (%) of responders reporting the provision of treatment modalities for which there were no formulated recommendations were patient education (n = 218; 99%), gait training (n = 208; 95%), active ROM exercises (n = 204; 93%), balance exercises (n = 188, 86%), passive ROM exercises (n = 126; 58%), aerobic exercises (n = 109; 50%), massage (n = 39; 18%) and cold therapy (n = 25, 11%).

Discussion

The present study showed that the recommendations in the Dutch PT guideline[15] regarding post-surgical PT were being followed by 95% or more of the physiotherapists in the study sample. Apart from the treatment modalities recommended in the guideline, many other PT interventions were being used by relatively large proportions of physiotherapists.

The recommendations in the Dutch guideline were in line with those made by Westby et al.[10], who advocated the use of muscle strengthening and functional exercises. However, in the study by Westby et al. >80% of the expert panel rated gait training and balance training as very important, while these interventions were not specified in the Dutch guideline recommendations. Westby et al. formulated no recommendations regarding physical modalities such as CPM and electric muscle stimulation. Patient education was not included in the Dutch guideline, whereas the expert panel in the study by Westby et al. rated monitoring for complications, position/ movement restrictions and return to driving as very important. These aspects were not examined in the present study. The difference between the elements of patient education advised by the expert panel in the study by Westby et al. and those considered relevant in the Dutch survey may indicate that there are differences between countries, and underline the need further to study the optimal content of patient education by physiotherapists after THA and TKA.

Table 2 Guideline recommendations and self-report post-operative physiotherapy by 219 physiotherapists regarding treatment of in hip and knee osteoarthritis patients undergoing joint replacement surgery.

	Treatment modalities		Number (proportion)
Recommended treatment modalities	Muscle strenghtening exercises		210 (96%)
	Functional exercises		218 (99%)
		Walking stairs	207 (95%)
		Rising and sitting down	198 (90%)
		Walking exercises outside	187 (85%)
		Cycling outside	87 (40%)
		Other individualized physical activities	125 (57%)
Treatment modalities which were neither recommended nor advised against	Continuous Passive Motion (CPM)	Other physical interventions	3 (1%)
Treatment modalities which were advised against	Electrical muscle stimulation after surgery		
Treatment modalities which were not included in the guideline	Active Range of Motion exercises		204 (93%)
	Aerobic exercises (included cycling insided on a hometrainer)		109 (50%)
	Gait training		208 (95%)
	Balance exercises		188 (86%)
	Massage		39 (18%)
	Heat therapy		0 (0%)
	Cold therapy		25 (11%)
	Passive Range of Motion exercises		126 (58%)
	Patient education after surgery		218 (99%)
	advice regarding scar tissue self-massage		90 (41%)
	advice regarding fluid balance in leg		148 (68%)
	loading restrictions		209 (95%)
	adaptations for at home		103 (47%)
	personal or domestic help		92 (42%)
	instructions for the use of walking aids		195 (89%)

The relatively high uptake of the recommendations in the Dutch guideline, as observed in the present study, is difficult to compare with other studies, as to our knowledge no other studies have addressed the adherence of physiotherapists to guidelines on THA or TKA management. In one survey study, which did not examine adherence to specific recommendations, but rather clinical practice in THA or TKA, 83% of the 35 physiotherapists studied reported providing exercises (open/closed chain and resistance exercises and biking) and 57% functional exercises (gait retraining, stairs, sitting to standing) postoperatively.[13] The present study showed that many treatment modalities other than those explicitly mentioned in the guideline were frequently applied. In particular, patient education, gait training, balance training and active ROM exercises were reported by over 80% of respondents. Whereas 99% of the respondents in the present study reported providing patient education, this figure was only 11% in the study by Naylor et al.[13] Our survey was broader than the recommendations included in the guideline alone, providing information not only on other treatment modalities, but also on the process of post-acute, postoperative PT care in THA and TKA. Regarding the delivery of care, most physiotherapists in our study provided individual postoperative PT, with 25% reporting group therapy in addition to individual therapy. In a survey by Artz et al.[14] from the UK, group therapy was found to be more common than individual therapy, and in the survey by Naylor et al.[13] 62% of patients who underwent TKA received group therapy and 75% individual treatment. Concerning the duration of postoperative PT, Naylor et al. reported an average duration of 5–6 weeks, whereas in our study 65% of physiotherapists reported an average duration of more than 12 weeks. Westby et al. [10] did not recommend a specific duration, but greatest support by the expert panel in that study was for 4–12 weeks, probably related to the fact that randomized controlled trials on postoperative PT in THA or TKA always concerned treatment protocols of 6–12 weeks. However, Westby et al. also stated that frequency and duration of treatment should be tailored to patients' specific needs and rehabilitation goals. The variation in post-acute rehabilitation in THA and TKA within and among studies has previously been noted in the literature.[10] This variation underlines the need to underpin far more interventions than those included in the Dutch guideline with evidence, and formulate clear recommendations about their use, irrespective of whether they are recommended, neither recommended nor advised against, or advised against. Moreover, the development of clear recommendations about the optimal timing, frequency, and duration of post-acute, postoperative PT after THA and TKA seems justified.

The observation that the guideline investigated in the present study mentioned only a few interventions explicitly, while many more are used in daily practice, points at a potential weak spot in the development of clinical practice guidelines: the selection of topics. It is important that this selection is made in close collaboration with the end-users of the guidelines, and that it includes in particular topics that are an indispensable aspect of care and reflect high-quality management. The update of the guideline

in the present study was done according to recommendations for the development of guidelines, with the selection of topics being done by an expert committee. The results suggest that more physiotherapists from clinical practice should be involved in the selection of topics for the guideline.

The present survey had a number of limitations. First, 219 of the 957 eligible physiotherapists responded. Only 31 stated that they were not treating patients after THA and TKA. It remains unclear how many of the other 707 physiotherapists did not see patients after THA and TKA but did not state this in the questionnaire, so it is difficult to calculate a true response rate. Assuming that all of them did treat patients after THA and TKA, the response rate would be 23%, but this is likely to be an underestimation. Nevertheless, this would be in line with the response rates seen in other Dutch surveys on the delivery of care among general physiotherapists; for example, response rates of 31% and 21% were found by Nijkrake et al.[17] and Bekkering et al.[18] respectively.

Second, in line with the study by Artz et al.[13], we did not gather data on THA and TKA separately. Outcomes after THA and TKA may differ, and information regarding the PT strategies in daily practice for THA as distinct from TKA can be valuable, as was also mentioned in the expert consensus recommendations by Westby et al.[10] Third, the information from the present study was based on self-report, so the provision of socially desired answers cannot be ruled out. Moreover, the question on CPM and electric muscle stimulation were combined. However, as only three physiotherapists indicated using these interventions, this does not influence the results regarding the use of these modalities. Finally, the answers of the physiotherapists represented an average of what they provided in daily practice. They were not able to give information on individual cases. It would be interesting to know the considerations and adaptations in treatment that are made in individual cases, such as patients with substantial co-morbidity.

In conclusion, we found that the recommendations in the Dutch PT guideline on post-acute, postoperative PT in THA and TKA were followed in daily practice. However, a considerable number of treatment modalities and the frequency, duration and intensity of PT after THA and TKA were not included in the guideline, leading to a large variation in the provision of care. In future research, the survey should be improved based on the mentioned limitations, and carried out nation- wide to confirm the results of the present study. Further research should then focus on modes of delivery and other treatment modalities on which recommendations can be formulated, including those that cannot be recommended, in order to provide more evidence and consensus-based recommendations on postoperative PT in hip and knee osteoarthritis and therefore improve the quality of PT care for THA and TKA patients.

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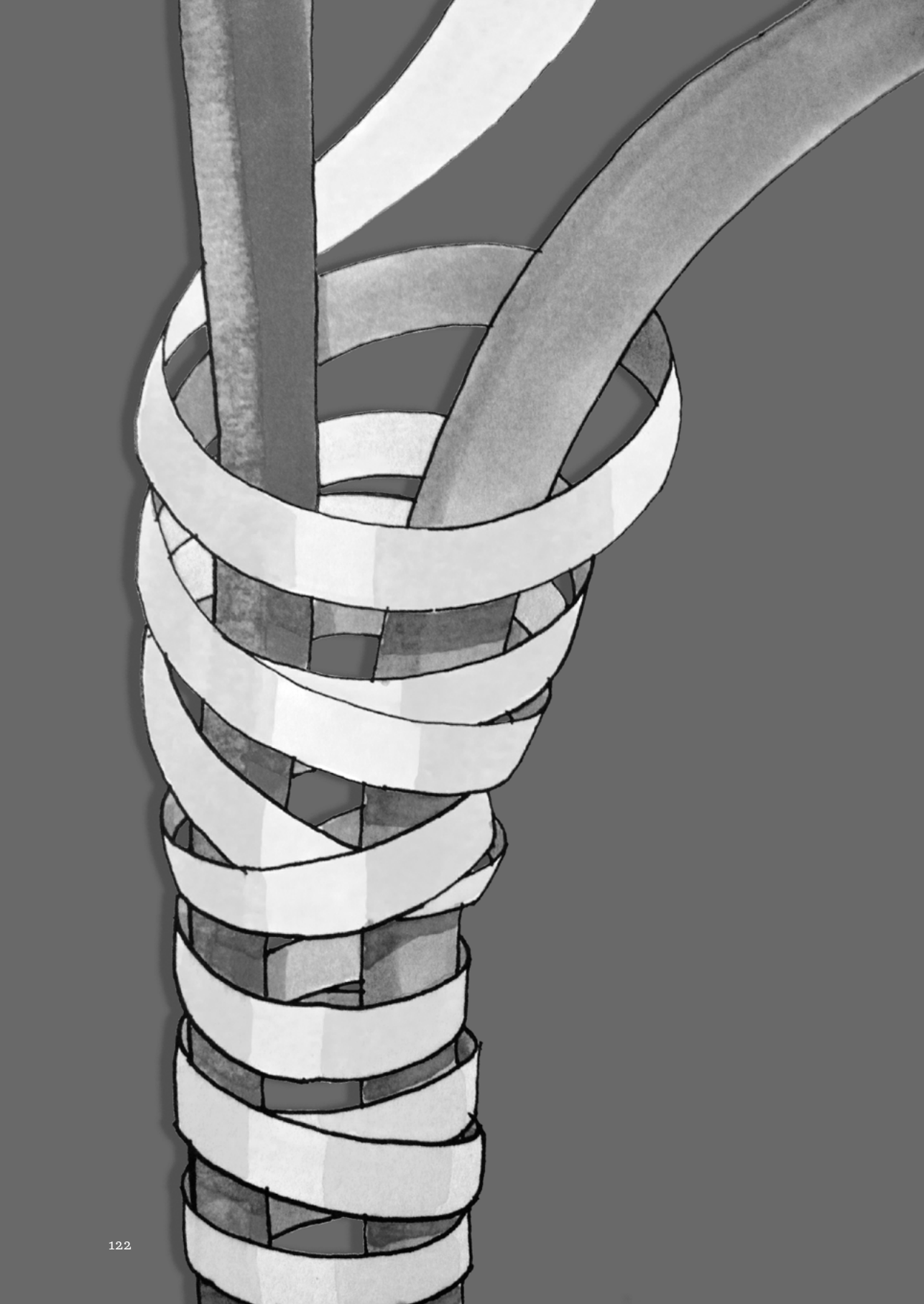

Chapter 7

The provision of preoperative and postoperative physiotherapy in elderly people with hip and knee osteoarthritis undergoing primary joint replacement surgery

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Abstract

Background and Purpose: The numbers of persons receiving total hip or knee arthroplasty (THA or TKA) are increasing worldwide. Although physiotherapy (PT) is considered to be a cornerstone in the rehabilitation, little is known of actual extent of delivery and its contents before and after surgery. The aim of the study was to describe the usage and characteristics of preoperative and postoperative PT among persons undergoing THA or TKA in the Netherlands as well as their determinants.

Methods: A survey was sent to 1005 persons who underwent THA or TKA in 4 hospitals in the previous year. It comprised questions regarding referral, setting, duration and content of preoperative and/or postoperative PT as well as participants' characteristics including sociodemographic characteristics, comorbidity, physical functioning and quality of life. The analysis consisted of descriptive statistics, a comparison of characteristics of participants who did and did not receive PT (Analysis of Variance, Mann-Whitney U or Chi-Square tests) and examination of the impact of age, sex, hospital, and time since surgery on features of PT (multivariate logistic regression analyses).

Results: The response rate was 52% (282 THA, 240 TKA), with 337 (65%) women, mean age 70.0 years (SD 9.3). Of the participants, 210 (40%) reported receiving preoperative PT and 514 (98%) postoperative PT, with similar proportions in THA and TKA. Female sex was the only participants characteristic related to the use of preoperative PT. Referrals were made by the orthopedic surgeon in 31% and 77% of participants receiving preoperative and postoperative PT, respectively. The most frequently (>60%) reported preoperative interventions were aerobic exercises and walking stairs and the most common postoperative interventions included aerobic, muscle strengthening and range of motion exercises, walking stairs, and gait training. Older age was related to fewer referrals by the orthopedic surgeon and a shorter duration of postoperative PT, whereas female sex was associated with a longer duration of postoperative PT. Moreover, the hospital and time since surgery were related to some features of preoperative and/or postoperative PT.

Discussion: In participants who underwent THA or TKA 40% reported the use of preoperative PT and almost all the participants used postoperative PT. There was considerable variation regarding the provided interventions, in particular before surgery.
The results of this study suggests the presence of practice variation, in line with the sparse literature. Conclusions must be interpreted with caution since this study concerned a self-generated survey and was retrospectively carried out in a limited number of hospitals in one country.

Conclusions: Larger, prospective studies including multiple hospitals and countries are needed to determine the extent of practice variation regarding the delivery of preoperative and postoperative PT. Their results, combined with cost-effectiveness studies on clearly defined PT interventions, may contribute to the optimization of care for persons undergoing THA or TKA.

Introduction

Hip and knee osteoarthritis (OA) are among the most prevalent chronic joint diseases, with total joint replacement being a very effective treatment option in the end stages.[1,2] A considerable number of persons undergo total hip arthroplasty (THA) or total knee arthroplasty (TKA): respectively 1.6 and 1.2 per 1000 people per year in 2009 in Western countries.[3] Due to the aging of society, the number of THAs and of TKAs are expected to increase in the coming years.[3]

Rehabilitation is integral to the care of individuals undergoing THA and TKA, with physiotherapy (PT) playing an important role in achieving functional independence and returning to work and recreational activities.[4-5] The current evidence underpinning the effectiveness of PT in THA or TKA mainly regards postoperative PT. Both a systematic review and two subsequent randomized controlled trials (RCTs) substantiate the effectiveness of postoperative PT regarding function, range of motion, and quality of life.[6-9] The literature is, however, less conclusive with respect to the effect of preoperative PT on functioning after THA and TKA.[10,11]

The most frequently reported PT interventions in joint replacement surgery are aerobic, muscle strengthening, and functional exercises.[6-11] Although not explicitly reported in the abovementioned literature, patient education is usually integrated into preoperative and postoperative PT.[12,13]

The precise content, frequency, duration, and timing of the PT program varies widely in total joint arthroplasty clinical trials.[6-11] A study of hospital PT departments in the United Kingdom concluded that PT was more common following TKA than THA, with group therapy including strengthening and stretching exercises most often being reported.[14] An Australian survey of hospital PT departments demonstrated the consistent provision of PT after TKA, but considerable practice variation with respect to the modes of rehabilitation and criteria for discharge from rehabilitation.[15] Overall, the perspective of persons undergoing joint replacement surgery on PT is rarely considered. In one patient survey, respondents reported that recovery after TKA would require more PT compared with THA.[16] In addition, a focus group study showed that, compared with health professionals, those undergoing THA or TKA had different, but overlapping views regarding rehabilitation practices and outcome.[17]

Practice variation and the disparity between the views of patients and health professionals could reflect knowledge gaps regarding the most effective timing, duration, dosage, and contents, as well as insufficient implementation, of evidence-based practices. There are, however, few studies available, so there is a need for more insight into the actual provision of PT in THA and TKA in daily practice. Moreover, to our knowledge no information from the patient perspective is available. Therefore, the purpose of this study was to describe the patient perspective of the usage and characteristics of preoperative and postoperative PT when undergoing THA or TKA. In addition, factors

potentially related to its usage and features were examined. The outcomes could guide both the research agenda with respect to perioperative PT as well as priorities for the improvement of the quality of care in THA and TKA.

Methods

Study design

This multicenter study had a retrospective design. It comprised a survey among persons who underwent THA or TKA in 2011 in one of four hospitals in the Netherlands: Leiden University Medical Center in Leiden (Hospital 1), Rijnland Hospital in Leiderdorp (Hospital 2), Groene Hart Hospital in Gouda (Hospital 3), and Reinier de Graaf Hospital in Delft (Hospital 4). Hospital 1 is an academic center, Hospitals 2 and 3 are general hospitals, and Hospital 4 is a large teaching hospital. Hospital 3 offered a group educational and exercise program to persons taking part in a fast-track THA or TKA program. This program provided a preoperative education session, functional exercises during hospital stay, and four sessions of exercises after discharge to groups of four persons undergoing the same procedure. The PT treatment in the other three hospitals was individualized.

Ethics

The study was carried out from July to October 2012, thus a potential minimum of 5 months and a maximum of 22 months after surgery. As this study concerned a survey filled in only once, it was judged to fall outside the remit of the Dutch law (Medical Research Involving Human Subjects Act; MO), and thus an exemption of medical ethical review was given by the Medical Ethical Committee of the Leiden University Medical Center. The study was conducted in accordance with the Handbook for Good Clinical Research Practice of the World Health Organization, and the Declaration of Helsinki principles [http://www.wma.net/en/30publications/10policies/b3/].

Recruitment of participants

Persons were eligible for the study if they underwent primary THA or TKA because of OA between January 1st and December 31st, 2011. Exclusion criteria were revision surgery and diagnoses other than OA (such as rheumatoid arthritis). In earlier surveys among outpatients with chronic musculoskeletal conditions performed by our group, response rates of about 60% were obtained.[18,19] We anticipated a somewhat lower response rate of about 40% in the group of persons undergoing THA and TKA, as they are not routinely monitored over the longer term. Taking this into account, and aiming to attain a total number of 400 completed questionnaires (200 THA and 200 TKA), we planned to invite 1000 persons. For that purpose, all persons with a diagnosis of primary THA or TKA in

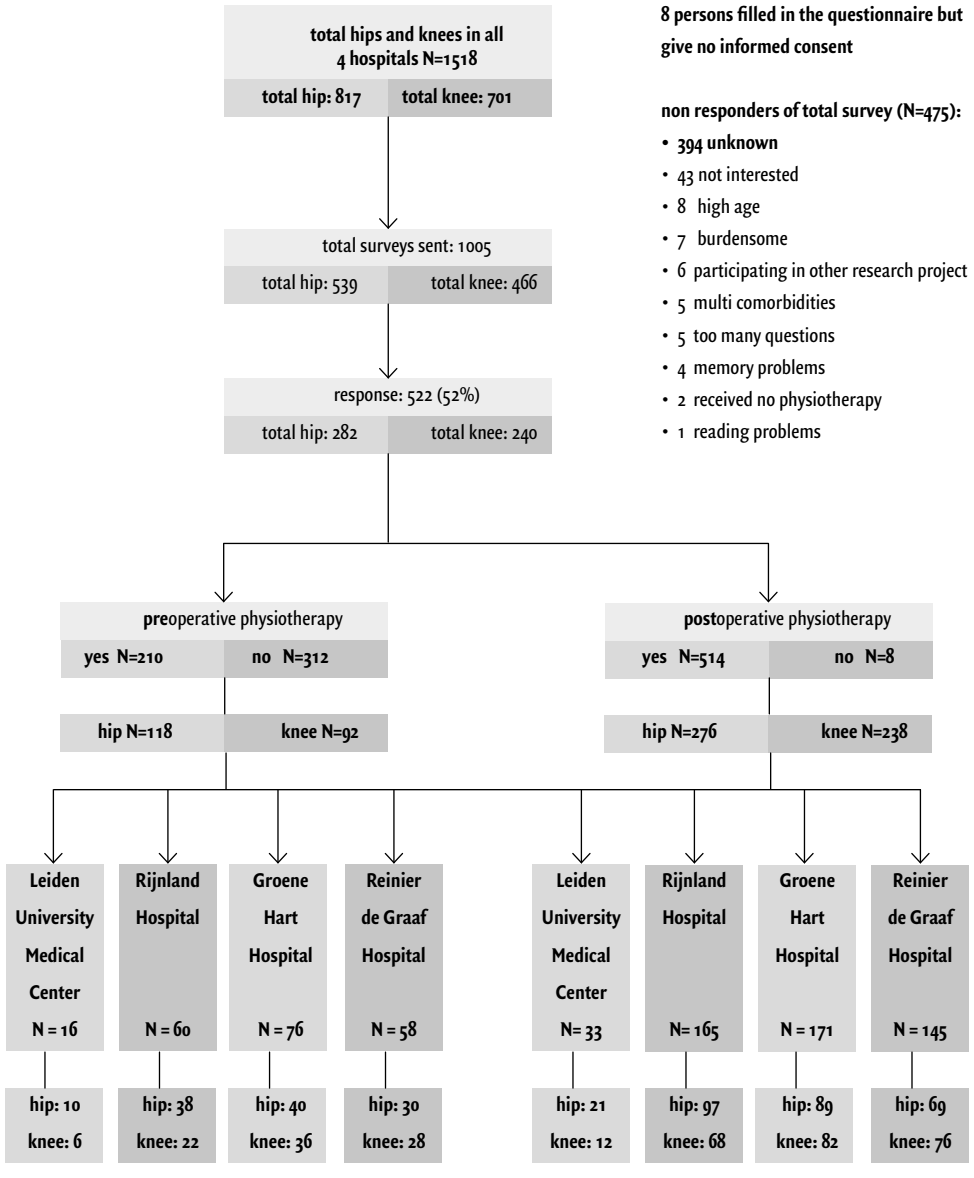

Figure Flowchart of participants and responses

the four hospital registries between January 1st and December 31st, 2011 were first identified. Subsequently, all persons with a diagnosis of hip or knee OA were selected.
In Hospitals 1 and 2, all eligible persons were invited. In Hospitals 3 and 4, selected eligible persons were invited, because the total number of persons undergoing THA or TKA was much larger than in the other two hospitals in the study period. Inviting all eligible persons in these hospitals would lead to a very uneven distribution of the sample sizes in the four hospitals. To ensure an equal distribution over the year in Hospitals 3 and 4, the past year was divided in four quarters. In each quarter an evenly amount of first consecutive persons who underwent surgery was selected.
In all hospitals, the treating orthopedic surgeon sent an invitation letter to all eligible persons, together with an information leaflet. The mailing also contained an informed consent form; the survey; and a pre-stamped, pre-addressed return envelope. Non-participants were asked if they were willing to provide the main reasons. No reminders were sent and we did not gather information on the non-responders.

Survey on PT provision

The survey comprised a set of questions regarding preoperative and postoperative PT (Appendix). The questions on postoperative PT were similar to those on preoperative PT, with separate questions for the post-acute phase directly after discharge from hospital, and for the chronic phase thereafter. The survey was pilot-tested on two persons who underwent THA and TKA, and the only changes were corrections to typographical errors.

Participants' characteristics and comorbidity

Participants' characteristics included:
• age (years),
• sex,
• length (cm) and weight (kg) to calculate the Body Mass Index (BMI),
• time since surgery,
• hospital where surgery took place.
To assess the presence of comorbidity, a questionnaire from the Dutch Central Bureau of Statistics (CBS) on 19 different comorbidities was used[20], as well as the Charnley Classification[21,22] (Class A: single joint arthroplasty and no significant medical comorbidity; Class B: one other joint in need of an arthroplasty, or an unsuccessful or failing arthroplasty in another joint; Class C: multiple joints in need of arthroplasty, multiple failing arthoplasties and/or significant medical or psychological impairment).

Physical functioning, quality of life, and satisfaction

Measures on current postoperative physical functioning included the Hip disability Osteoarthritis Outcome Score (HOOS) and the Knee injury Osteoarthritis Outcome Score (KOOS).[23,24] These are self-reported questionnaires comprising the following subscales:

symptoms; stiffness; pain; function, daily living; function, sports and recreational activities; and quality of life. For this survey, the subscale "function, daily living" was used to assess physical functioning: it consists of 17 items in both the HOOS and KOOS.[23,24] Quality of life was measured with the Short Form (SF) 36 questionnaire.[25] The SF36 contains 8 subscales, which can be transformed into a physical and mental component summary scale (PCS and MCS) by means of a norm-based scoring method.[25] The score of these summary scales ranges from 0-100, with a higher score indicating better quality of life.

Statistical Analysis

Descriptive statistics were used for the characteristics of the participants and the provided PT. Analysis of Variance (with Post-Hoc Bonferroni tests, if appropriate), the Mann-Whitney U test, or Chi Square test, where appropriate, were used to compare response rates, characteristics of participants, and features of PT; among the four hospitals, participants undergoing THA versus TKA, and participants either receiving or not receiving preoperative or postoperative PT. In addition, we analyzed the impact of four factors, divided into participants characteristics (age and sex), provider characteristics (hospital), and study design (time since surgery) on the provision of PT. Thus, independent variables included age (< 70 versus ≥ 70), sex, hospital (1, 2, 3, or 4), and time since surgery (< 15 weeks versus ≥ 15 weeks), whereas the dependent features of preoperative and postoperative PT were mode of referral (orthopedic surgeon versus other), frequency (once versus twice weekly or more), duration (less or more than 12 weeks), and the provision of each of the following four interventions: active exercises (yes/no), passive exercises (yes/no), physical modalities (yes/no), and patient education (yes/no) by means of multivariate logistic regression analyses (method enter).
All data were analyzed using the SPSS statistical package (version 20.0, SPSS, Chicago, Illinois). The level of statistical significance was set at .05 for all analyses.

Results

Response

The flow of participants in this study is presented in the Figure. Fifteen hundred and eighteen persons received THA or TKA for OA in the four participating hospitals. According to the inclusion criteria, 1005 persons were selected, of whom 539 (53.6%) underwent THA and 466 (46.4%) TKA. Of the 1005 persons, 530 (52.7%) returned the survey. Eight persons completed the survey but did not provide informed consent, resulting in 522 (51.9%) persons being included: 282/539 (52.3%) THA and 240/466 (51.5%) TKA. The response proportions in Hospitals 1, 2, 3, and 4 were 64.8%, 61.6%, 52.1%, and 42.3% respectively. Of the 475 non-responders, 81 (17.1%) returned the survey stating the reasons why they did not want to participate: not interested (n = 43, 53.1%), too old (n = 8, 9.9%), finding participation too burdensome (n = 7, 8.6%), or miscellaneous reasons (n = 23, 28.4%).

Participant characteristics

Table 1 shows the characteristics of the 522 participants. The only significant differences between the THA and TKA group were a significantly higher average BMI, a lower proportion of participants in Charnley Class A, a higher proportion of participants in Charnley Class C, and a lower mean physical functioning score in the TKA group compared with the THA group. The only differences in baseline characteristics of the participants in the four hospitals were a significantly lower mean SF36 PCS score in Hospital 2 (M = 38.6, SD = 6.3) compared with Hospitals 3 (M = 47.9, SD = 8.1) and 4 (M = 47.0, SD = 8.0), p < .005, different proportions of male TKA participants (66.7%, 29.3%, 41.6%, and 22.7% in Hospitals 1, 2, 3, and 4 respectively), p = .006, and different proportions of participants who underwent THA and were classified as Charnley C (81.8%, 50.0%, 50.7%, and 40.6% in Hospitals 1, 2, 3, and 4 respectively), p = .007.

In total, 210 participants (40.2%) received preoperative PT and 514 participants (98.5%) postoperative PT, with the proportions being similar in THA and TKA and in all four hospitals. In the acute phase after surgery, 78 (47.6%) of the 172 participants from Hospital 3 reported participation in the fast-track program: 42 (46.7%) participants with THA and 36 (43.9%) participants with TKA. The 210 participants who received preoperative PT did not differ from the participants who did not receive preoperative PT, on any of the sociodemographic and health characteristics, except for sex (proportions female 70.5% and 60.1% respectively: p = .02).

Table 1 Characteristics# of 522 participants with hip and knee osteoarthritis undergoing joint replacement surgery in 2011

Variabele	All patients (N=522)	Total Hip (N=282)	Total Knee (N=240)	P-value
Sex, female	337 (64.6%)	179 (63.4%)	158 (65.8%)	0.55
Age, years, mean (SD)	70.0 (9.3)	69.9 (9.5)	70.2 (9.0)	0.92
Body Mass Index, mean (SD)	27.8 (4.7)	26.7 (4.1)	29.2 (5.1)	<0.001*
Time since surgery, months (SD)	15.0 (3.5)	14.9 (3.5)	15.2 (3.5)	0.36
Hospital				
1. Leiden University Medical Center	35 (7.0%)	22 (7.8%)	13 (5.4%)	0.28
2. Rijnland hospital	172 (33.0%)	90 (31.9%)	82 (34.2%)	0.59
3. Groene Hart hospital	148 (28.4%)	71 (25.2%)	77 (32.1%)	0.08
4. Reinier de Graaf hospital	167 (32.0%)	99 (35.1%)	68 (28.3%)	0.10
HOOS† or KOOS† physical functioning; mean (SD)	78.9 (20.8)	81.4 (18.8)	76.1 (22.7)	0.01*
SF36 mental component summary scale; mean (SD)	47.7 (7.7)	48.0 (7.6)	47.5 (7.8)	0.61
SF36 physical component summary scale; mean (SD)	45.4 (8.6)	45.6 (8.9)	45.2 (8.2)	0.54
Charnley Classification (N=505)				
Class A	125 (24.7%)	81(29.9%)	44 (18.6%)	0.004*
Class B	102 (20.2%)	56 (20.7%)	46 (19.7%)	0.78
Class C	278 (55.0%)	134 (49.4%)	144 (61.5%)	0.006*
Coexisting disorders (N=521)				
None	29 (5.6%)	20 (7.1%)	9 (3.8%)	0.10
One coexisting disorder	136 (26.1%)	78 (27.8%)	58 (24.2%)	0.35
Two or more coexisting disorders	356 (68.3%)	183 (65.1%)	173 (72.1%)	0.09
Preoperative physiotherapy	210 (40.2%)	118 (41.8%)	92 (38.3%)	0.42
Postoperative physiotherapy	514 (98.5%)	277 (98.2%)	237 (99.8%)	0.63

All variables expressed as numbers (%), unless stated otherwise

* Statistically significant difference (P < 0.05; Chi-square test or an Mann-Whitney U test, where appropriate)

† Hip disability / Knee injury Osteoarthritis Outcome Score (HOOS/KOOS)

Table 2. Self-reported characteristics of preoperative physiotherapy in 210 participants with hip and knee osteoarthritis undergoing joint replacement surgery: referral, setting, duration and mode of delivery

Variable % (95% Confidence Interval)	Hip (N=118)	Knee (N=92)	p-value
Referral			
Orthopedic surgeon	23.7% (16.6-32.6)	40.2% (30.3-51.0)	0.006*
General practitioner	36.4% (27.9-45.9)	25.0% (16.8-35.3)	0.10
Direct access to physiotherapy without referral	26.3% (18.8-35.3)	22.8% (15.0-33.0)	0.65
Setting			
Primary care only	89.8% (82.6-94.4)	90.2% (81.8-95.2)	0.93
Primary and secondary care	10.2% (5.6-17.4)	9.8% (4.9-18.2)	0.86
Average frequency			
Once per week	65.5% (55.0-72.9)	57.6% (46.9-67.7)	0.24
Twice per week	32.7% (24.1-41.5)	41.3% (31.3-52.1)	0.20
3 times per week or more	1.7% (0.0-6.6)	1.1% (0.1-6.8)	0.70
Duration			
2-4 weeks	14.4% (8.2-21.4)	17.2% (9.7-25.8)	0.59
5-8 weeks	20.7% (13.0-28.0)	21.8% (13.2-30.6)	0.85
9-12 weeks	19.8% (12.3-27.1)	17.2% (9.7-25.8)	0.64
More than 12 weeks	45.0% (33.4-51.8)	43.7% (31.3-52.1)	0.85
Time between last physiotherapy session and surgery			
less than one week	23.0% (15.1-30.8)	36.4% (25.4-44.9)	0.04*
1-2 weeks	34.5% (24.8-42.4)	28.4% (18.7-37.6)	0.36
3-5 weeks	14.2% (8.2-21.4)	13.6% (7.2-22.1)	0.92
6 weeks or more	28.3% (19.5-36.2)	21.6% (13.2-30.6)	0.28
Mode of delivery			
Individual	77.1% (68.3-84.1)	81.5% (71.8-88.6)	0.44
Group therapy	16.1% (10.2-24.3)	15.2% (8.9-24.6)	0.76
Aquatic therapy	1.7% (0.3-6.6)	4.3% (1.4-11.4)	0.24

* Differences between persons undergoing Total Hip Arthroplasty and Total Knee Arthroplasty were calculated by means of a Mann-Whitney U test or Chi-square test where appropriate. The alpha level of statistical significance was set at 0.05

Table 3. Content of self-reported preoperative physiotherapy in 210 participants with hip and knee osteoarthritis undergoing joint replacement surgery

Variable % (95% Confidence Interval)	Hip (N=118)	Knee (N=92)	P-value
Exercises (more than one possible answer)			
Any form of active exercises	86.4% (78.6-91.8)	97.8% (91.6-99.6)	0.003*
Muscle strengthening exercises	32.2% (24.1-41.5)	55.4% (44.7-65.7)	0.001*
Active Range of Motion exercises	39.0% (30.3-48.4)	32.6% (23.4-43.3)	0.34
Aerobic exercises (including cycling indoors on a home trainer)	61.0% (51.6-69.7)	70.7% (60.1-79.5)	0.15
Gait training (including instructions how to use walking aids)	46.6% (36.6-55.2)	53.3% (42.6-63.6)	0.28
Balance exercises	15.3% (9.5-23.3)	15.2% (8.9-24.6)	0.99
Any form of functional exercises	80.5% (72.0-87.0)	80.4% (70.6-87.7)	0.99
Walking stairs	62.7% (53.3-71.3)	64.1% (53.4-73.7)	0.83
Rising and sitting down	53.4% (44.0-62.6)	57.6% (46.9-67.7)	0.54
Walking exercises	37.3% (28.7-46.7)	40.2% (30.3-51.0)	0.67
Cycling outside	13.6% (8.2-21.4)	17.4% (10.6-27.0)	0.44
Other individualized physical activities	20.3% (13.7-29.0)	9.8% (4.9-18.2)	0.04*
Passive Range of Motion (by manual exercises or machines)	36.4% (27.9-45.9)	51.1% (40.5-61.6)	0.03*
Physical modalities			
Any form of physical modalities	29.7% (21.8-38.9)	30.4% (21.5-41.0)	0.9
Massage	25.4% (18.1-34.4)	19.6% (12.3-29.4)	0.32
Heat therapy	3.4% (1.1-9.0)	9.8% (4.9-18.2)	0.06
Ice packs	0	9.8% (4.9-18.2)	0.001*
Other physical modalities	3.4% (1.1-9.0)	4.3% (1.4-11.4)	0.72
Patient education related to surgery and rehabilitation (more than one possible answer)			
Any form of patient education	77.1% (68.3-84.1)	84.8% (75.4-91.1)	0.16
Joint replacement surgical procedure	39.8% (31.1-49.3)	53.3% (42.6-63.6)	0.05
Exercises after surgery	49.2% (39.9-58.5)	56.3% (45.8-66.7)	0.29
Allowed daily activities after surgery	48.3% (39.1-57.7)	52.2% (41.6-62.6)	0.58
Loading restriction after surgery	49.2% (39.9-58.5)	52.2% (41.6-62.6)	0.66
Possible necessary adaptations to be prepared at home(after surgery)	44.9% (35.8-54.3)	29.3% (20.6-39.9)	0.02*
Possible necessary personal or domestic help (after surgery)	27.1% (19.5-36.2)	31.5% (22.5-42.2)	0.49
Possible necessary walking aids (after surgery)	57.6% (48.2-66.6)	59.8% (49.0-69.7)	0.75

* Differences between participants undergoing Total Hip Arthroplasty and Total Knee Arthroplasty were calculated by means of a Mann-Whitney U test or Chi-square test where appropriate. The alpha level of statistical significance was set at 0.05.

Table 4. Self-reported characteristics of postoperative physiotherapy in 487 participants# with hip and knee osteoarthritis undergoing joint replacement surgery: referral, setting, duration and mode of delivery

Variable (%; 95% Confidence Interval)	Hip (N=260)	Knee (N=227)	p-value
Referral	(N=249)	(N=222)	
Orthopedic surgeon	74.3% (68.3-79.5)	83.0% (77.6-87.9)	0.007*
General practitioner	6.0% (3.5-9.9)	1.8% (0.6-4.9)	0.02
Direct access to physiotherapy without referral	19.7% (15.0-25.3)	14.8% (10.6-20.4)	0.20
Setting			
Primary care only	92.7% (88.6-95.4)	96.9% (93.5-98.6)	0.04*
Primary and secondary care	7.3% (4.6-11.4)	3.1% (1.4-6.5)	0.07
Average frequency	(N=254)	(N=225)	
Once per week	40.6%; 34.5-46.9)	25.3% (19.9-31.6)	<0.001*
Twice per week	58.3% (51.9-64.4)	68.0% (61.4-74.0)	0.03*
3 times per week or more	1.2% (0.3-3.7)	6.7% (3.9-11.0)	0.002*
Duration	(N=249)	(N=214)	
2-4 weeks	10.4% (7.1-15.1)	7.5% (4.5-12.1)	0.27
5-8 weeks	22.9% (17.9-28.7)	21.5% (16.3-27.7)	0.72
9-12 weeks	23.3% (18.3-29.1)	20.6% (15.5-26.7)	0.48
More than 12 weeks	43.4% (37.2-49.8)	50.5% (43.6-57.3)	0.13
Mode of delivery	(N=231)	(N=217)	
Individual	89.2% (84.3-92.7)	83.9% (78.1-88.4)	0.80
Group therapy	10.4% (6.9-15.2)	14.3% (10.1-19.8)	0.12
Aquatic therapy	0.4% (0.0-2.8)	1.8% (0.6-5.0)	0.13

Excluding 27 participants
(17 THA and 10 TKA) who used postoperative PT in secondary care (hospital, rehabilitation center or nursing home)

* Differences between participants undergoing THA and TKA were calculated by means of a Mann-Whitney U test or Chi-square test where appropriate. The alpha level of statistical significance was set at 0.05.

Table 5. Content of self-reported postoperative physiotherapy in 487 participants# with hip and knee osteoarthritis undergoing joint replacement surgery

Variable % (95% Confidence Interval)	**Hip (N=260)**	**Knee (N=227)**	P-value
Exercises (more than one possible answer)			
Any form of active exercises	95.0% (91.4-97.2)	93.8% (89.7-96.5)	0.57
Muscle strengthening exercises	57.3% (51.0-63.4)	65.2% (58.6-71.3)	0.08
Active Range of Motion exercises	70.7% (63.6-75.1)	70.2% (63.1-75.4)	0.99
Aerobic exercises (included cycling indoors on a home trainer)	73.1% (67.2-78.3)	75.8% (69.6-81.1)	0.16
Gait training (including instructions how to use walking aids)	82.3% (77.0-86.6)	78.4% (72.4-83.5)	0.28
Balance exercises	54.2% (48.0-60.4)	53.7% (47.0-60.3)	0.91
Any form of functional exercises	89.2% (84.7-92.6)	84.1% (78.6-88.5)	0.59
Walking stairs	62.3% (56.1-68.2)	62.1% (55.4-68.4)	0.97
Rising and sitting down	61.9% (55.7-67.8)	57.3% (50.6-63.7)	0.30
Walking exercises	56.5% (50.3-62.6)	50.2% (53.6-56.9)	0.16
Cycling outside	16.9% (12.7-22.2)	18.1% (13.4-23.8)	0.74
Other individualized physical activities	17.7% (13.4-23.0)	15.9% (11.5-21.4)	0.26
Passive Range of Motion (by manual exercises and machines)	36.9% (31.1-43.1)	59.9% (53.2-66.3)	<0.001*
Physical modalities			
Any form of physical modalities	31.5% (26.0-37.6)	42.3% (35.8-49.0)	0.014*
Massage	28.1% (22.8-34.0)	34.4% (28.3-41.0)	0.18
Heat therapy	0.8% (0.1-3.1)	1.8% (0.6-4.8)	0.32
Ice packs	0	6.7% (3.9-10.9)	<0.001*
Other physical modalities	5.8% (3.4-9.5)	9.3% (6.0-14.0)	0.14
Patient education related to surgery and rehabilitation (more than one possible answer)			
Any form of patient education	81.2% (75.8-85.6)	77.1% (71.0-82.3)	0.40
Allowed daily activities after surgery	63.8% (57.7-69.6)	51.1% (44.4-57.8)	0.004*
Loading restriction after surgery	66.9% (60.8-72.5)	65.6% (59.0-71.7)	0.77
Possible necessary adaptations to be prepared at home	17.3% (12.7-22.2)	14.5% (10.4-20.0)	0.47
Possible necessary personal or domestic help	15.0% (11.0-20.1)	11.9% (8.1-17.0)	0.32
Possible necessary walking aids	36.9% (31.1-43.1)	35.2% (29.1-41.9)	0.70

Excluding 27 participants
(17 THA and 10 TKA) who used postoperative PT in secondary care (hospital, rehabilitation center or nursing home)

* Differences between participants undergoing THA and TKA were calculated by means of a Mann-Whitney U test or Chi-square test where appropriate. The alpha level of statistical significance was set at 0.05.

Preoperative PT

Characteristics of preoperative PT: referral, setting, frequency, duration, and mode of delivery

Table 2 shows the characteristics of provided PT as reported by 210 participants. A significantly larger proportion of participants was referred by the orthopedic surgeon in the TKA group compared with the THA group. Overall, about a quarter of the referrals were self-referrals in both the THA and TKA groups. Preoperative PT was provided in primary care and on an individual basis in the large majority of participants, with two thirds of the participants reporting an average frequency of once per week, and slightly more than half of them registering a duration of less than 12 weeks in both the THA and the TKA groups. In more than half of the participants, preoperative PT was continued until surgery (significantly higher proportion in TKA than in THA) or until two weeks before surgery.

Content of preoperative PT

Table 3 shows the reported content of preoperative PT. The large majority of participants received some form of active exercise. The proportion of participants who reported receiving active exercises was, however, significantly higher in the TKA (97.8%) than in the THA group (86.4%) (p = .003).

With respect to the type of exercise, aerobic exercises and walking stairs were each reported by the largest proportions of participants (> 60%), whereas gait training and rising and sitting down were reported by 49% or more of the participants in the THA and the TKA groups. All other exercises were each reported by 42% or less of the participants. There were no significant differences in the rates of provision of the different active treatment forms between the THA and the TKA groups, except for a significantly higher proportion of participants who reported muscle strengthening exercises in the TKA (55.4%) than in the THA group (32.2%). Passive Range of Motion (ROM) exercises (42.9%) and massage (22.9%) were the most frequently employed passive interventions, with passive ROM exercises being significantly more often reported by participants undergoing TKA (51.1%) than undergoing THA (36.4%).

With respect to the provision of education on topics related to the planned surgery, the possible need for walking aids after surgery was the most frequently addressed topic (58.6%). In addition, post-surgical exercises, allowed daily activities, and loading restrictions were reported by about half of the participants. Significantly more participants in the THA group (44.9%) than in the TKA group (29.3%) reported the receipt of information on the possible need for home adaptations after surgery. Otherwise there were no other differences between THA and TKA groups.

Characteristics of participants and hospitals related to features of preoperative PT

In the multivariate analyses there were only two factors associated with any of the features of preoperative PT: the hospital was related to the proportion of referrals made by the orthopedic surgeon (proportion of participants referred to Hospital 1: 60.0%, Hospital 2: 31.0%, Hospital 3: 34.7%, and Hospital 4: 22.2%, with p=0.05), and to longer time between surgery and the provision of physical modalities (7-14 months: 50.5%, 15-22 months 35.6%, with p=0.03).

Postoperative PT

Characteristics of postoperative PT: referral, setting, frequency, duration, and mode of delivery

Table 4 shows the characteristics of postoperative PT, which was used by 514 of 522 (98.5%) participants. In the post-acute phase, 265 of these 514 participants used PT only in a primary care private practice or at home (51.6%), whereas 249 participants (48.4%) first (*n* = 222) or only (*n* = 27) had postoperative PT in a secondary care setting (i.e. hospital, rehabilitation center, home for the elderly, nursing home, or care hotel). Thus, in total, 487 (94.7%) used postoperative PT in a primary care practice and/or at home.

The 249 participants who used postoperative PT in secondary care in the post-acute phase, with or without primary care PT thereafter, were significantly older: 71.3 years, SD 9.0 versus 68.7, SD 9.3, p = .01, and had a lower HOOS / KOOS physical functioning mean score: 76.4, SD 22.4 versus 81.2, SD 19.0, p = .02 than the participants only using PT in primary care in the post-acute phase.

Referrals to postoperative PT were made by the orthopedic surgeon in three quarters of the participants (significantly more often in TKA than in THA). The duration was more than 12 weeks in about half of the participants, with most participants reporting an average frequency of twice per week. The proportions of participants reporting an average frequency of twice per week or three times per week or more were significantly higher in the TKA group (74.7%) than in the THA group (59.5%).

Content of postoperative PT

Table 5 shows that postoperative PT was mainly provided on an individual basis. Muscle strengthening, aerobic, balance control, and active ROM exercises; gait training; walking stairs; rising and sitting down; and walking were reported by 50% or more of the participants in both the THA and TKA groups. Passive ROM exercises were reported by about half of the participants, yet significantly more frequently in the TKA (59.9%) than in the THA group (36.9%). Massage was the most frequently reported physical modality (31.0%). Regarding the provision of education, the surgery-related topics that were most frequently reported included allowed daily activities (57.9%), which had a significantly higher proportion in THA (63.8%) than in TKA (51.1%), and information on loading restrictions (66.3%).

Regarding the characteristics of primary care postoperative PT, the only significant difference between the group of participants who had PT in primary care only (*n* = 265) and those who had also used PT in secondary care in the post-acute phase as well (*n* = 222) was that the latter group showed relatively more participants who reported an average frequency of once per week (38.1%) and a duration of less than 9 weeks (37.5%) compared with treatment in primary care alone: 29.5%, p = .05 and 26.2%, p = .008 respectively (results not shown).

Characteristics of participants and hospital related to features of postoperative PT

In the multivariate analyses, older participants were found to be less frequently referred (73.1%) than younger participants (81.9%) to postoperative PT by orthopedic surgeons, (p=0.02), and older participants less often (41.6%), and women more often (51.0%), received treatment for more than 12 weeks, compared with younger participants (51.5%) and men (39.5%), (p= 0.03 and p=0.02, respectively). The hospital was related to the duration (more than 12 weeks); Hospital 1: 76.7%, Hospital 2: 52.3%, Hospital 3: 41.6%, and Hospital 4: 39.2%, with p=0.001, frequency of treatment(twice per week); Hospital 1: 71.9%, Hospital 2: 57.5%, Hospital 3: 71.9%, and Hospital 4: 56.0%, with p=0.01, and the provision of passive exercise; Hospital 1: 62.5%, Hospital 2: 52.3%, Hospital 3: 61.3%, and Hospital 4: 52.3%, with p=0.02. Time since surgery was not related to any features of postoperative PT.

Discussion

A survey among 1005 persons undergoing THA and TKA showed that respectively 41.8% and 38.3% received preoperative PT and 98.2 % and 99.8% postoperative PT. Regarding the proportions of participants who had preoperative PT, we have no other studies for comparison, as all previous research on PT usage in THA and TKA concerned postoperative PT. Although the evidence for the effectiveness of preoperative PT in THA and TKA is scant,[10] it is conceivable that it is, nevertheless, used in daily practice. This could be based on the observation that in conditions other than OA, a faster recover after surgery was achieved in high risk persons with PT .[26] However, in our study the participants who received preoperative PT did not appear to be a selection of high-risk persons. Their characteristics did not, apart from sex, differ from those who did not receive preoperative PT. The considerable rate of usage of preoperative PT should, however, be interpreted with some caution. Its duration was more than 12 weeks in over 44% of the participants who used it, self-referrals or referrals by the General Practitioner (GP) were more common than referrals by the orthopedic surgeon, and the waiting list for THA and TKA in the Netherlands was relatively short (4 to 6 weeks) at the time the study was conducted. Therefore it is possible that, in some participants, preoperative PT was rather a continuation of the non-surgical management

of hip or knee OA than a specific program aimed at improving postoperative outcomes. Regarding the characteristics of preoperative PT, our data can only be compared with the characteristics of preoperative PT programs as described in clinical trials, such as those included in the systematic review by Hoogeboom et al.[10] In that review, the number of sessions ranged between 2.5 and 3 times a week, with a duration of 4 to 8 weeks, while the results of our study suggest a lower frequency (once a week in 66% (THA) and 58% (TKA)) and longer duration (more than 9 weeks in 65% (THA) and 61% (TKA)) in many participants in daily practice. The programs in the RCTs included in that review contained resistance, aerobic, and functional exercises,[10] similar to the reported contents of PT in our study. However, in our study, an active ROM and balance exercises, gait training, and various types of functional exercises were also reported by many participants.

In line with the literature, postoperative PT was reported by almost all participants, suggesting that physician referrals and self-referrals in the post-acute phase are consistently and routinely done. In our study, almost all participants received postoperative PT on an individual basis in primary care, while previous studies only reported on PT in the hospital setting.[14,15] Artz et al[14] found that 11 of 23 orthopedic centers in the UK referred persons to an exercise group. In the Netherlands, postoperative group exercise programs are not commonly available primary care and secondary care. The mean frequency of postoperative PT reported by Naylor et al[15] was twice a week, whereas, in our study, 63% received PT twice a week, but the other participants had a lower frequency of postoperative PT. The duration of treatment cannot be directly compared between the studies.

Concerning the types of interventions, our findings are largely in line with those of previous studies, concluding that strengthening, stretching, gait training, and task oriented exercises were those most often provided after THA and TKA[14] and that the rates of provision of active and functional exercises after TKA were 83% and 57% respectively.[15] The rates cannot be directly compared, however, as the previous studies were based on physical therapists' estimations, whereas we used the reports of individual participants.

Taking into account the reported features of PT, overall the variation in exercises appeared to be larger with preoperative than with postoperative PT. This is based on the observation that there were fewer exercise modalities that were reported by 60% or more of the participants with preoperative PT than with postoperative PT. The larger practice variation could be related to the absence of evidence on its effectiveness. The variation could also be related to the fact that preoperative PT was for some patients probably not based on a specific program to prepare for the operation. Moreover, the relatively high reported proportions (> 40%) of passive ROM exercises and massage (> 22%) before and after surgery in our study are noteworthy. Although the passive

treatment modalities were combined with active exercises in all participants, the provision of these interventions seems in contrast to the literature, where an active approach is often recommended.[6-9] Finally, in our study, patient education on one or more topics related to surgery was provided as part of PT to about 80% of participants both before and after surgery. This is partly comparable to reported preoperative education rates in a review by Wallis et al[13], but difficult to compare with the provision of postoperative education rates reported by Westby et al,[17] since detailed information is missing.

We examined the provision of PT for THA and TKA separately. This led to a number of interesting observations, such as differences in the individuals' characteristics as well as the features of their treatment, despite overall similar usage rates. The observation that in TKA the duration of postoperative PT was longer than in THA is in line with the results of De Beer et al [16], suggesting that rehabilitation after TKA is different from THA.

Age, sex, hospital, and time since surgery were significantly related to some of the reported features of preoperative and postoperative PT. Older age seemed to be related to fewer referrals by the orthopedic surgeon and a shorter duration of postoperative PT, whereas female sex was associated with a longer duration of postoperative PT. Moreover, the hospital had an impact on some features of preoperative or postoperative PT. The observation that the time since surgery, a consequence of the retrospective study design, was also related to some outcomes, underpins the need for a prospective study.

A strength of our study is that, in contrast to the approach used in previous research, we used the patient perspective. By only using data from health care providers, in particular orthopedic departments, information on persons who refer themselves to PT or are referred by GPs is lost. We demonstrated in our study that the numbers of self-referrals and referrals made by GPs are considerable. Moreover, this approach was helpful to gather information on variation in actually provided treatment modalities as part of PT among individual persons, which was indeed considerable.

This study has a number of limitations. First, it concerned a self-generated survey, which was not validated by reviewing individual medical records or data from health care insurers. Therefore, the provision of socially desired answers, incorrect interpretation of the questions, and recall bias cannot be totally ruled out. Indeed, time since surgery was found to have an impact on the reporting of the use of some features of PT. Another limitation of the study is that it was done in only four hospitals in one country and that the response rate was 52%, so that the results may not be generalizable to all patients undergoing THA or TKA. Nevertheless, the sociodemographic and clinical characteristics of the participants were quite similar to those of persons who underwent THA or TKA in other observational studies,[14-16] so selection bias may be limited. Finally, the retrospective nature of the study as well as the lack of detail regarding the actual dosage of PT interventions do not allow an adequate analysis of the impact of

the use of preoperative and postoperative PT, as well as its features, on the outcomes of THA or TKA. All these limitations underline the need to conduct studies with a prospective design, including multiple hospitals in, preferably, multiple countries. Studies should include subjects as long before the operation as possible and register the preoperative health status, as well as describe preoperative and postoperative PT usage and other health care usage. The use of more objective sources of information, such as medical records on health care usage is strongly advocated. However, it should be noted that physicians may not routinely record referrals to PT, and persons can also refer themselves. Moreover, for PTs, the standardized registration of a fixed set of features of individual treatments is still uncommon.

Conclusions

In this retrospective study of older persons who underwent THA or TKA, almost all persons received postoperative PT and 40% received preoperative PT. Preoperatively, there was considerable variation in PT treatment interventions. The reported features of PT were associated with age, sex, the hospital, and time since surgery. The results should be interpreted cautiously due to the limited response, the retrospective nature of the study, and the fact that it was carried out in a specific area in one country. Despite these limitations, the observed practice variation observed in this relatively small study warrants future, prospective research. In addition to cost-effectiveness studies on clearly defined PT interventions, such research may contribute to the optimization of care for persons undergoing THA or TKA.

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Appendix.

Survey on preoperative and postoperative physiotherapy in persons with osteoarthritis undergoing total hip and total knee surgery

Characteristics of preoperative and postoperative physiotherapy

1. Before surgery: Did you receive physiotherapy in the three months before surgery?

☐ Yes ☐ No

After surgery: Did you receive physiotherapy after surgery?

☐ Yes ☐ No

2. If so, who referred you?:

☐ orthopedic surgeon,
☐ general practitioner
☐ direct access

3. Where did the PT took place?:

☐ primary care, i.e. private practice or at your home
☐ hospital
☐ rehabilitation center
☐ home for the elderly
☐ nursing home
☐ care hotel

4. What was the average frequency of physiotherapy?

☐ once a week
☐ twice a week
☐ three times per week or more

5. What was the duration of physiotherapy?

☐ 2-4 weeks
☐ 5-8 weeks
☐ 9-12 weeks
☐ more than 12 weeks

6. What was the time between the last physiotherapy session and surgery?

☐ less than one week
☐ 1-2 weeks
☐ 3-5 weeks
☐ more than 6 weeks

7. What was the delivery mode of physiotherapy?

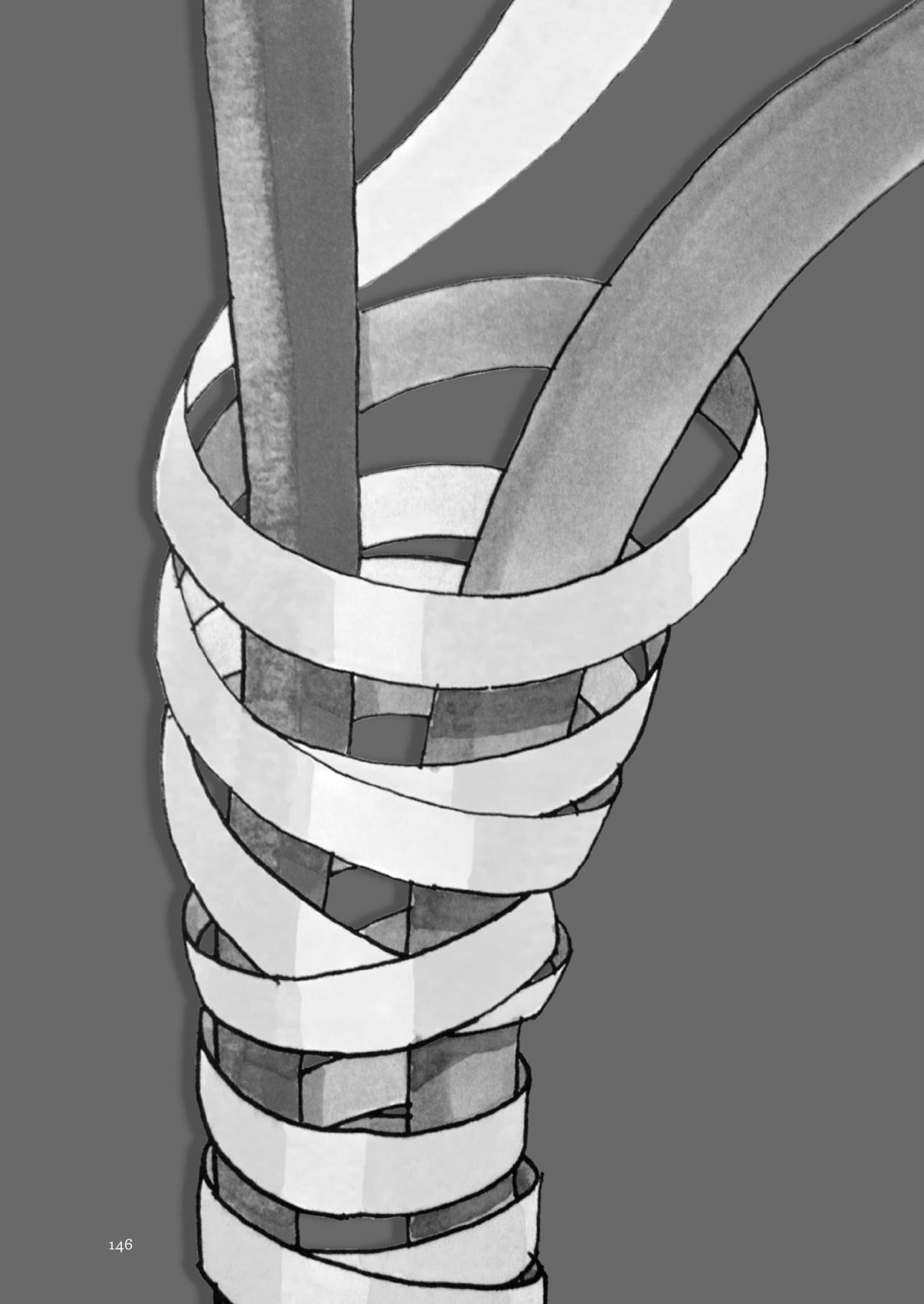
☐ individual
☐ group
☐ aquatic therapy

8. Which of the following physiotherapy modalities were provided (more than one possible answer)?

☐ Muscle strengthening exercises
☐ Active exercises to move the joints
☐ Aerobic exercises (including cycling indoors on a home trainer)
☐ Gait training (quality of walking and instructions how to use walking aids)
☐ exercises
☐ Walking stairs
☐ Rising and sitting down
☐ Walking exercises (speed, distance)
☐ Cycling outside
☐ Other individualized physical activities
☐ Moving of the leg by the physiotherapist
☐ Massage
☐ Heat therapy
☐ Ice packs
☐ Other physical modalities

9. Which of the following aspects of patient education related to surgery and rehabilitation were provided (more than one possible answer)?

☐ Joint replacement surgical procedure (only asked before surgery)
☐ Exercises after surgery (only asked before surgery)
☐ Allowed daily activities after surgery
☐ Loading restriction after surgery
☐ Possible necessary adaptations to be prepared at home
☐ Possible necessary personal or domestic help
☐ Possible necessary walking aids



Chapter 8

Comorbidity in patients with osteoarthritis undergoing total hip or knee replacement surgery

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Abstract

Objecive To evaluate the presence and associations of comorbidities with pain, physical functioning and health related quality of life (HRQoL) after THA or TKA.

Methods A cross-sectional retrospective survey including 19 specific comorbidities, administered in patients who underwent THA or TKA in the previous 7-22 months in one of 4 hospitals. Outcome measures included pain, physical functioning, and HRQoL.

Results Of the 521 patients (281 THA and 240 TKA) included, 449 (86%) had ≥1 comorbidities. The most frequently reported comorbidities (>15%) were: severe back pain; neck/shoulder pain; elbow, wrist or hand pain; hypertension; incontinence of urine; hearing impairment; vision impairment; and cancer. Only the prevalence of the latter was significantly different between THA (n=38; 14%) and TKA (n=52; 22%) (p=0.01). Higher number of comorbidities was more associated with outcome in THA than in TKA as compared to no comorbidities. In multivariate analyses including all comorbidities with a prevalence of >5%, dizziness in combination with falling and severe back pain in THA, and dizziness, vision impairments, and elbow, wrist or hand pain in TKA, were mostly associated with outcome.

Conclusions A broad range of specific comorbidities needs to be taken into account during recovery and rehabilitation period after surgery. Specifically the presence of severe back pain in THA and dizziness in THA and TKA should maybe ascertained before surgery and if present be treated if possible in order to decrease the chance of an unfavourable outcome, although the predictive value of dizziness should be confirmed in a study with a prospective design.

Introduction

Total joint replacement surgery is a very effective treatment option in end-stages of hip and knee osteoarthritis (OA), By 2009, the numbers of patients undergoing Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA) have risen up to 1.6 and 1.2 per 1000 per year in Western countries.[1] In the Netherlands 55.000 THA and TKA are implanted annually.[2] These numbers are expected to further increase in coming years, due to the ageing society and the growing prevalence of obesity.[1]

Although the outcomes of THA and TKA are in general favorable with respect to pain, daily activities and health related quality of life (HRQoL), 7-34% of patients are not satisfied with the result of surgery [3]. One of the factors playing a role in a poor outcome after THA and TKA was found to be the presence of comorbidity.[4] Comorbidity can be categorized into musculoskeletal disorders other than hip or knee OA (e.g. low back pain or involvement of other joints) or non-musculoskeletal disorders (e.g. hypertension, diabetes, heart failure or obesity).[5] In patients with hip or knee OA in general, comorbidity was found to be highly prevalent and affecting physical functioning and HRQoL.[5-7]

Regarding the presence of comorbidity in patients with hip or knee OA undergoing THA or TKA, any form of comorbidity was reported in 73% of 893 Finnish patients waiting for THA or TKA.[8] The reported prevalence of specific comorbidities in THA and TKA patients varies in recent studies: hypertension in 18-64%[9-13]; heart failure in 6-32%[11,12,14-16] ; diabetes in 4-24%[8-13,15,16] ; Chronic Obstructive Pulmonary Disease (COPD) in 6-13%[9,10,15,16] ; and back pain in 31-37%[11,12,14] of patients with THA and/or TKA.

Concerning the association of the *number of comorbidities* and the outcomes of THA and TKA it was found that an increasing number of affected joints was associated with worse post-surgical pain, physical function, and mental scores[14,17], and HRQoL scores.[17,18] With respect to the *nature of specific comorbidities,* associations with worse outcomes regarding pain, physical functioning or HRQoL were reported for neck, ankle/feet/toes pain[16], back pain[19], and stroke[20] in TKA, hypertension[21] in THA, obesity[21], and heart disease[15,16] in both THA and TKA. In all of these studies, the outcomes were determined after 1-5 years of follow-up.

So far, the literature on the associations of comorbidity with outcome in patients with hip or knee OA undergoing THA and TKA often focused on one or a limited number of comorbidities.[16,19,22] If more specific comorbidities were considered, data were in some cases only presented at the level of average comorbidity scores.[14,17,18,23] The latter obscures the effect of specific comorbidities as well their (combined) impact on the patients' health status. Moreover, regarding the outcomes of THA and TKA, pain and physical functioning rather than HRQoL[14,18], were considered.

In daily practice orthopaedic surgeons take the presence of comorbidity into account in their decision for surgery, in part by using the ASA (American Society of Anesthesiologists) classification to identify patients with high risk of decease and not high risk of worse surgical outcome.[24]

In 2012, 65% of patients undergoing THA or TKA in the Netherlands were classified as ASA II (mild systemic disease) and 11% as ASA III-IV (severe systemic disease without or with constant threat of life).[3] These figures indicate that comorbidity, both systemic as well as affecting specific organs, will be present in both THA and TKA patients and may influence postoperative outcome.

Although the often used Charnley Classification[25,26] provides information on comorbidity to take into account worse functional outcome, this classification contains no information on specific forms of comorbidity.

Given the lack of knowledge on the incidence and associations of a wide range of specific comorbidities and the outcome of THA and TKA, the aim of this study was

1. To describe the presence of various specific musculoskeletal and non-musculoskeletal comorbidities in patients who underwent THA and TKA.
2. To describe the associations of the combination of the number and the nature of specific comorbidities with pain, physical functioning, and HRQoL after surgery.

Method

Study design

This study had a cross-sectional design. It was a part of multi-center survey concerning the use of physiotherapy[27] among consecutive patients who underwent THA or TKA in 2011 in 4 hospitals (Leiden University Medical Center, Leiden; Rijnland Hospital, Leiderdorp; Groene Hart Hospital, Gouda; and Reinier de Graaf Hospital Delft, the Netherlands). The study was carried out from July to October 2012, with a minimum of 7 months and a maximum of 22 months after surgery. This study was setup as a survey to be completed once, and therefore judged to fall outside the remit of the Dutch law on Medical Research Involving Human Subjects Act (WMO) and an exemption for medical ethical review was given by the Medical Ethical Committee of the Leiden University Medical Center after checking the precision of the protocol. The study was conducted in accordance with the Handbook for Good Clinical Research Practice of the World Health Organization, and Declaration of Helsinki principles [http://www.wma.net/en/30publications/10policies/b3/].

Recruitment of patients

Patients diagnosed with hip or knee OA were eligible for the study if they were 18 years or older and underwent primary THA or TKA between January 1st and December 31th 2011.

Exclusion criteria were surgery for diagnoses other than OA and revision surgery.

We aimed to obtain total number of 400 completed questionnaires (200 THA and 200 TKA). Anticipating a response rate of 40%, we planned to invite 1000 patients from 4 different hospitals. Selection was done by means of hospital registries. All patients in whom the diagnosis primary THA or TKA was made between January 1st and December 31st 2011 were first selected, subsequently all patients with a diagnosis of hip or knee OA, and age 18 years or older were identified. In hospital 1 all eligible persons were invited. In hospital 2 the survey was sent to all persons who were already participating in a prospective study and underwent surgery in 2011. In hospitals 3 and 4 equal proportions of eligible persons were asked for participation, with the number of persons to be invited in each hospital being divided evenly over the four quarters of the year in which the surgery was performed. In the latter two hospitals only a proportion of patients was invited, in order to obtain relatively equal numbers of patients in the 4 hospitals.

In all 4 hospitals the treating orthopedic surgeon sent a letter explaining the study and requesting the patient to participate, together with an informed consent form, the survey and a pre-stamped, pre-addressed envelope to all selected patients. After patients signed the informed consent form they were included in the study. No information was obtained on the patients who did not respond.

Sociodemographic and personal characteristics

Sociodemographic characteristics included age (years), sex, level of education (low, medium and high), and marital status (living alone, yes/no). In addition, patient's height (cm) and weight (kg) were recorded (to calculate the Body Mass Index), as well as their smoking status (current smoker yes/no).

Presence of comorbidities

Information on comorbidities was gathered with two questionnaires:

First, a comorbidity questionnaire developed by the Dutch Central Bureau of Statistics (CBS) questionnaire[28] was used, asking for the presence or absence of 19 different comorbidities in the previous year, divided in three domains: *Musculoskeletal comorbidities:* severe back pain (including slipped disc); severe neck or shoulder pain; severe elbow, wrist or hand pain; other chronic rheumatic diseases; *Non-musculoskeletal comorbidities:* asthma or COPD (Chronic Obstructive Pulmonary Disease); (severe) cardiac disorder or coronary disease; arteriosclerosis (abdomen or legs); hypertension; (consequences of) stroke; severe bowel disorder; diabetes mellitus; migraine; psoriasis; chronic eczema; cancer; incontinence of urine; *Sensory impairments:* hearing impairments (group and face-to-face conversation); vision impairments (short and long distance); dizziness in combination with falling.

Table 1 Characteristics# of 521 patients who underwent Total Hip Arthroplasty or Total Knee Arthroplasty in 2011

Variable	All patients (N=521)	Total Hip (N=281)	Total Knee (N=240)	p-value
Sex, female (N=515)	336 (65.2%)	178 (64.0%)	158 (66.7%)	0.53
Age, years (mean, SD)	70.0 (9.3)	69.8 (9.5)	70.1 (9.0)	0.88
Body Mass Index (BMI) (mean, SD) (N=508)	27.8 (4.7)	26.7 (4.1)	29.2 (5.1)	**<0.001***
BMI < 25	150 (29.5%)	100 (36.6%)	50 (21.3%)	**<0.001***
BMI 25-30 (overweight)	217 (42.7%)	123 (45.1%	94 (40.0%)	0.25
BMI 30-40 (obesity)	135 (26.6%)	49 (17.9%)	86 (36.6%)	**<0.001***
BMI > 40 (morbid obesity)	6 (1.2%)	1 (0.4%)	5 (2.1%)	0.07
Current smoker (N=507)	44 (8.7%)	29 (10.5%)	15 (6.5%)	0.11
Education level (N=400)				
Low	160 (40.0%)	82 (38.5%)	78 (41.7%)	0.51
Medium	151 (37.8%)	76 (35.7%)	75 (40.1%)	0.36
High	89 (22.2%)	55 (25.8%)	34 (18.2%)	0.07
Marital status, living alone (N=365)	109 (29.9%)	55 (28.8%)	54 (31.0%)	0.64
HOOS or KOOS pain; mean (SD) (n=400)	81.7 (19.1)	84.0 (17.1)	79.0 (20.9)	**0.021***
HOOS or KOOS physical functioning; mean (SD) (N=391)	78.9 (20.9)	81.3 (18.9)	76.1 (22.7)	**0.027***
SF36 physical component summary scale; mean (SD) N=401)	45.4 (8.6)	45.6 (8.9)	45.2 (8.2)	0.54
SF36 mental component summary scale; mean (SD) (N=401)	47.7 (7.7)	48.0 (7.6)	47.5 (7.8)	0.61
Charnley Classification (N=505)				
Class A	125 (24.8%)	81 (29.9%)	44 (18.8%)	**0.004***
Class B	102 (19.6%)	56 (19.9%)	46 (19.2.%)	0.78
Class C	278 (55.0%)	134 (49.4%)	144 (61.5%)	**0.006***
Musculoskeletal comorbidities				
Severe back pain (hernia included)	97 (18.6%)	46 (16.4%)	51 (21.3%)	0.15
Severe neck / shoulder pain	101 (19.4%)	50 (17.8%)	51 (21.2%)	0.32
Severe elbow, wrist or hand pain	86 (16.5%)	43 (15.3%)	43 (17.9%)	0.42
Other rheumatic diseases	65 (12.5%)	30 (10.7%)	35 (14.6%)	0.18
Non-musculoskeletal comorbidities				
Asthma or COPD	59 (11.3%)	29 (10.3%)	30 (12.5%)	0.43
(Severe) cardiac disorder or coronary disease	55 (10.6%)	31 (11.0%)	24 (10.0%)	0.70
Arteriosclerosis in abdomen and legs	32 (6.1%)	18 (6.4%)	14 (5.8%)	0.79
Hypertension	220 (42.2%)	108 (38.4%)	112 (46.7%)	0.06
(Consequences) of a stroke	31 (6.0%)	14 (5.0%)	17 (7.1%)	0.31
Severe bowel disorder	23 (4.4%)	10 (3.6%)	13 (5.4%)	0.30
Diabets Mellitis	70 (13.4%)	31 (11.0%)	39 (16.2%)	0.08
Migraine	33 (6.3%)	16 (5.7%)	17 (7.1%)	0.52
Psoriasis	16 (3.1%)	9 (3.2%)	7 (2.9%)	0.85
Severe eczema	21 (4.0%)	12 (4.3%)	9 (3.8%)	0.76
Cancer	90 (17.3%)	38 (13.5%)	52 (21.7%)	**0.01***
Incontinence of urine	96 (18.4%)	53 (18.9%)	43 (17.9%)	0.78
Sensory impairments				
Hearing impairments (group conversation)	139 (26.7%)	68 (24.2%)	71 (29.6%)	0.17
Hearing impairments (face-to-face conversation)	20 (3.8%)	9 (3.2%)	11 (4.6%)	0.41
Vision impairments (short distances)	94 (18.0%)	52 (18.5%)	42 (17.5%)	0.77
Vision impairments (long distances)	45 (8.6%)	30 (10.7%)	15 (6.2%)	0.07
Dizziness in combination with falling	32 (6.1%)	15 (5.3%)	17 (7.1%)	0.41
Number of comorbidities				
0	72 (13.8%)	45 (16.0%)	27 (11.2%)	0.12
1 or 2	232 (44.5%)	130 (46.3%)	102 (42.5%)	0.39
3 or 4	133 (25.6%)	69 (24.5%)	64 (26.7%)	0.58
≥ 5	84 (16.1%)	37 (13.2%)	47 (19.6%)	**0.047***

All variables expressed as numbers (%), unless stated otherwise

* Statistical significant difference between Total Hip and Total Knee patients by means of a Mann-Whitney or Chi-square test where appropriate

Secondly, we used the self-reported Charnley Classification[25,26] which consists of three categories: patients are assigned to class A if they have single joint arthropathy and no significant medical comorbidity. Class B patients have one other joint in need of an arthroplasty, or an unsuccessful or failing arthroplasty in another joint, while class C patients have multiple joints in need of arthroplasty, multiple failing arthoplasties or significant medical or psychological impairment.

Physical functioning, pain and HRQoL

Information on current postoperative physical functioning was collected by means of the pain and physical functioning subscales of the Hip disability Osteoarthritis Outcome Score (HOOS)[29], and the Knee injury Osteoarthritis Outcome Score (KOOS).[30] The pain subscale consists of 10 and 9 (different) items in the HOOS and KOOS, respectively, whereas the physical functioning subscale comprises the same 17 items regarding activities in daily life in both HOOS and KOOS. The score range is 0-100, with higher scores meaning less pain and better physical functioning.

HRQoL was measured with the Short Form -36 questionnaire (SF36).[31] The SF36 contains 8 subscales (physical functioning; role limitations due to physical health problems; bodily pain; general health perceptions; vitality; social functioning, role limitations due to emotional problems; and general mental health). Scores on the subscales were transformed into two component scores; a mental and physical component summary score. By using data from a Dutch general population, norm-based scores (relative to an average score in the general population of 50) were calculated.[31] For all subscale scores and summary scores the score range is 0-100, with higher scores indicating a better health status.

Statistical Analyses

Patients' characteristics, presence of different specific comorbidities, pain, physical functioning, and HRQoL scores were illustrated by using descriptive statistics. Differences between patients undergoing THA and TKA were examined by means of Mann-Whitney-U or Chi-square tests.

First, multivariate regression models were employed to study the relationship of the number of comorbidities with the four outcomes. For this purpose, the number of comorbidities was categorized into four groups: 1-2 comorbidities, 3-4 comorbidities and 5 or more comorbidities, with 0 comorbidities being the reference group.

Separate multivariate regression analyses were employed to study the association of the presence of specific comorbidities occurring in >5% of the patients with the four outcomes; pain, physical functioning, and the HRQoL physical and mental component summary scales.

Subsequently, all comorbidities and potential confounders which were significantly associated with the outcomes were included in final multivariate regression models.

All the analyses were corrected for BMI, whereas the analyses with pain and physical functioning as dependent variables were also adjusted for sex and age (SF36 scores were calculated using norm data so that correction for age and sex would be redundant).

All data were analysed using the SPSS statistical package (version 20.0, SPSS, Chicago, Illinois). The level of statistical significance was set at $p < 0.05$ for all analyses.

Results

Study population

In total 1005 patients were requested to complete the survey in the 4 participating hospitals. Of these patients 539 (53.6%) underwent THA and 466 (46.4%) TKA. The response to the survey was 521/1005 (51.8%) for the total group, with 281/539 (52.1%) patients responding in the THA and 240/466 (51.5%) in the TKA groups.

Table 1 shows the baseline characteristics of the study population. Two-thirds of the patients were female (65.2%), their mean age was 70.0 (SD 9.3) years and the mean BMI 27.8 (SD 4.7), with the latter being significantly lower in the THA group as compared to the TKA group (26.7 (SD 4.1) and 29.2 (SD 5.1), respectively (P<0.001)). There were significantly more obese (BMI 30-40) patients in the TKA group than in the THA group (36.6% and 17.9% respectively, p<0.001), while no difference regarding the frequency of morbid obesity (BMI>40) was seen between THA and TKA.

The average pain and physical functioning scores as measured by the HOOS and KOOS, respectively, were significantly higher in the THA group than in the TKA group (p=0.021 and p=0.027, respectively), whereas the SF36 mental and physical component summary scales did not differ between THA and TKA.

Table 2a Associations between the number of comorbidities and pain, physical functioning and quality of life in 281 patients after THA

Number of comorbidities	**Pain # (H/KOOS subscale)**		**Physical functioning # (H/KOOS subscale)**		**Quality of Life † (SF36 physical component summary scale)**		**Quality of Life † (SF36 mental component summary scale)**	
	mean (SD)	B (95% CI)	mean (SD)	B (95% CI)	mean (SD)	B (95% CI)	mean (SD)	B (95% CI)
0	93.6 (8.7)		93.5 (9.3)		49.7 (9.7)		49.8 (4.4)	
1 and 2	86.5 (17.0)	-6.6 (-13.7; 0.4)	84.3 (18.1)	**-8.6 (-16.4; -0.9)***	46.6 (8.4)	-2.9 (-6.2; 0.4)	48.2 (7.8)	-1.7 (-4.7; 1.3)
3 and 4	79.8 (17.0)	**-12.8 (-20.9; -4.7)***	77.3 (18.0)	**-14.9 (-23.8; -6.1)***	42.9 (8.1)	**-6.5 (-10.2; -2.8)***	47.0 (8.2)	-3.0 (-6.3; 0.4)
5 and more	76.1 (18.1)	**-15.9 (-25.3; -6.4)***	69.2 (21.7)	**-22.1 (-32.4; -11.7)***	41.8 (7.9)	**-7.1 (-11.7; -2.5)***	46.5 (9.2)	-3.8 (-7.9; 0.3)

Statistical analyses by means of a multivariate regression analyses adjusted for age, sex and BMI

† Statistical analyses by means of a multivariate regression analyses adjusted for BMI

* Statistical significance ($p < 0.05$)

Table 2b Associations between the number of comorbidities and pain, physical functioning and quality of life in 240 patients after TKA

Number of comorbidities	**Pain #** (H/KOOS subscale)		**Physical functioning #** (H/KOOS subscale)		**Quality of Life †** (SF36 **physical** component summary scale)		**Quality of Life †** (SF36 **mental** component summary scale)	
	mean (SD)	B (95% CI)	mean (SD)	B (95% CI)	mean (SD)	B (95% CI)	mean (SD)	B (95% CI)
0	76.2 (20.7)		66.5 (23.0)		48.7 (6.4)		48.7 (8.8)	
1 and 2	84.3 (18.7)	7.3 (-3.3; 17.8)	83.0 (18.4)	16.1 (4.8; 27.5)	47.3 (7.5)	-1.2 (-5.5; 3.1)	49.5 (5.8)	1.1 (-2.8; 5.1)
3 and 4	74.9 (22.8)	-1.2 (-12.7; 10.2)	75.5 (23.6)	10.0 (-2.4; 22.3)	43.9 (8.6)	-4.5 (-9.2; 3.1)	46.5 (9.3)	-1.7 (-6.0; 2.7)
5 and more	74.6 (21.0)	-1.6 (-13.4; 10.1)	65.7 (24.8)	-0.2 (-13.0; 12.5)	41.7 (8.6)	-6.7 (-11.4; -2.0)*	44.6 (7.6)	-3.6 (-8.0; 0.8)

Statistical analyses by means of a multivariate regression analyses adjusted for age, sex and BMI

† Statistical analyses by means of a multivariate regression analyses adjusted for BMI

* Statistical significance ($p < 0.05$)

Table 3a Associations between the presence of specific comorbidities and pain, physical functioning, and quality of life in 281 patients following Total Hip Arthroplasty #

		Pain (H/KOOS subscale)			**Physical functioning** (H/KOOS subscale)			**Quality of Life (%)** (SF36 **physical** component summary scale)			**Quality of Life (%)** (SF36 **mental** component summary scale)		
Variable		mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2
Musculoskeletal disorders													
Severe back pain (hernia included)	present	76.7 (20.7)	-8.6*	0.061	71.1 (22.8)	-12.4*	0.099	42.0 (8.2)	-4.2*	0.099	49.2 (6.6)	1.8	0.046
	absent	85.5 (15.9)	(-14.8; -2.4)		83.3 (17.4)	(-19.2; -5.6)		46.3 (8.8)	(-7.3; -1.0)		47.7 (7.8)	(-0.9; 4.6)	
Severe neck / shoulder pain	present	80.6 (16.4)	-3.4	0.032	74.6 (21.0)	-7.6*	0.063	43.3 (8.1)	-2.4	0.079	46.7 (9.3)	-1.1	0.041
	absent	84.7 (17.2)	(-9.8; 3.0)		82.6 (18.2)	(-14.6; 0.6)		46.1 (8.9)	(-5.5; 0.8)		48.2 (7.2)	(-3.9; 1.7)	
Severe elbow, wrist or hand pain	present	82.9 (15.5)	-0.2	0.027	75.1 (20.0)	-5.6	0.052	44.4 (8.8)	-0.5	0.070	44.8 (9.1)	-3.1*	0.057
	absent	84.2 (17.4)	(-6.9; 6.6)		82.4 (18.5)	(-12.6; 1.6)		45.8 (8.9)	(-3.9; 2.9)		48.5 (7.3)	(-6.0; -0.1)	
Other rheumatic diseases	present	80.8 (20.4)	-3.6	0.032	75.6 (21.0)	-6.3	0.052	45.1 (8.1)	-0.6	0.070	46.7 (9.6)	-1.3	0.041
	absent	84.4 (16.6)	(-11.0; 3.7)		82.0 (18.5)	(-14.4; 1.9)		45.7 (8.9)	(-4.6; 3.3)		48.1 (7.4)	(-4.7; 2.2)	
Non-musculoskeletal disorders													
Asthma or COPD	present	76.5 (16.1)	-7.5	0.044	70.3 (19.5)	-11.0*	0.072	43.4 (8.7)	-0.6	0.070	46.5 (8.9)	-0.9	0.039
	absent	84.8 (17.0)	(-15.1; 0.2)		82.5 (18.4)	(-19.4; -2.6)		45.9 (8.9)	(-4.4; 3.3)		48.1 (7.5)	(-4.5; 2.8)	
(Severe) cardiac disorders	present	75.4 (22.3)	-9.7*	0.060	75.0 (23.1)	-7.2	0.056	45.1 (9.3)	-0.6	0.070	47.3 (9.1)	-0.9	0.039
	absent	85.1 (16.1)	(-16.9; -2.6)		82.1 (18.2)	(-15.1; 0.8)		45.7 (8.8)	(-4.4; 3.3)		48.0 (7.5)	(-4.2; 2.5)	
Arteriosclerosis in abdomen and legs	present	71.4 (20.1)	-13.3*	0.059	67.4 (23.8)	-13.1*	0.071	42.1 (6.6)	-3.7	0.080	48.2 (7.3)	0.2	0.038
	absent	84.8 (16.6)	(-23.2; -3.4)		82.1 (18.3)	(-23.2; -3.0)		45.9 (8.9)	(-8.6; 1.1)		47.9 (7.7)	(-4.1; 4.5)	
Hypertension	present	82.5 (17.9)	-2.2	0.031	79.7 (19.6)	-1.6	0.043	43.6 (8.4)	-2.2	0.084	47.8 (8.5)	0.2	0.038
	absent	84.9 (16.6)	(-7.1; 2.7)		82.3 (18.4)	(-7.0; 3.9)		46.7 (8.9)	(-4.7; 0.2)		48.1 (7.1)	(-1.9; 2.4)	
(Consequences of) a stroke	present	75.2 (19.3)	-8.9	0.044	68.5 (20.5)	-15.2*	0.069	42.3 (7.7)	-3.0	0.076	43.4 (9.1)	-4.5*	0.058
	absent	84.6 (16.8)	(-18.1; 0.3)		82.2 (18.5)	(-26.8; -3.7)		45.9 (8.9)	(-7.9; 1.8)		48.2 (7.4)	(-8.7; -0.3)	
Diabetes Mellitis	present	87.9 (12.6)	5.1	0.036	86.6 (12.7)	7.0	0.054	42.5 (8.5)	-2.7	0.078	49.3 (7.2)	2.0	0.044
	absent	83.5 (17.6)	(-2.1; 12.5)		80.7 (19.4)	(-1.2; 15.1)		46.0 (8.8)	(-6.6; 1.2)		47.8 (7.7)	(-1.4; 5.4)	

Table 3a - Continued

		Pain (H/KOOS subscale)			**Physical functioning** (H/KOOS subscale)			**Quality of Life (%)** (SF36 **physical** component summary scale)			**Quality of Life (%)** (SF36 **mental** component summary scale)		
Variable		mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2
Migraine	present	83.6 (15.5)	0.4	0.027	76.3 (20.2)	-4.2	0.044	45.0 (8.0)	0.2	0.070	44.3 (10.9)	-3.3	0.048
	absent	84.0 (17.2)	(-9.7; 10.4)		81.6 (18.8)	(-15.2; 6.8)		45.7 (8.9)	(-4.9; 5.2)		48.2 (7.4)	(-7.7; 1.1)	
Cancer and malignant diseases	present	80.4 (18.8)	-3.8	0.034	75.6 (19.7)	-6.1	0.055	45.8 (7.6)	0.9	0.071	50.2 (6.4)	3.0†	0.058
	absent	84.7 (16.7)	(-10.0; 2.5)		82.4 (18.5)	(-12.9; 0.8)		45.6 (9.1)	(-2.4; 4.2)		47.6 (7.8)	(0.2; 5.8)	
Incontinence of urine	present	81.3 (17.7)	-1.4	0.028	76.8 (18.3)	-3.4	0.046	42.4 (8.8)	-2.5	0.080	45.4 (8.9)	-2.2	0.049
	absent	84.6 (16.9)	(-7.6; 4.8)		82.4 (18.9)	(-10.3; 3.4)		46.3 (8.7)	(-5.7; 0.7)		48.5 (7.2)	(-5.0; 0.6)	
Sensory impairments													
Hearing impairments (group conversation)	present	80.7 (17.0)	-2.7	0.041	76.6 (19.6)	-4.1*	0.067	44.2 (8.7)	.1.3	0.079	46.6 (8.4)	-1.1	0.043
	absent	85.1 (17.0)	(-6.2; 0.7)		83.0 (18.3)	(-7.8; -0.4)		46.1 (8.9)	(-3.1; 0.4)		48.4 (7.3)	(-2.7; 0.4)	
Vision impairments (short distances)	present	81.4 (16.0)	-1.3	0.034	77.8 (17.2)	-2.0	0.051	44.4 (8.4)	-0.6	0.070	47.6 (8.1)	0.3	0.034
	absent	84.7 (17.4)	(-5.2; 2.7)		82.3 (19.2)	(-6.2; 2.3)		45.9 (8.9)	(-2.6; 1.4)		48.0 (7.5)	(-1.4; 2.1)	
Vision impairments (long distances)	present	79.5 (14.9)	-2.1	0.032	72.4 (19.0)	-3.4	0.050	43.2 (8.3)	-1.0	0.069	46.2 (8.4)	-0.9	0.035
	absent	84.6 (17.3)	(-7.5; 3.3)		82.5 (18.6)	(-9.2; 2.4)		45.9 (8.9)	(-4.0; 2.0)		48.1 (7.5)	(-3.6; 1.7)	
Dizziness in combination with falling	present	70.1 (18.4)	-12.9*	0.048	56.5 (23.9)	-23.7*	0.105	38.1 (8.7)	-6.1	0.086	43.6 (11.0)	-3.3	0.045
	absent	84.6 (16.9)	(-25.0; -0.9)		82.4 (17.9)	(-36.0; -11.5)		45.9 (8.7)	(-12.3; 0.0)		48.1 (7.4)	(-8.7; 2.1)	

For all variables associations are calculated with linear multivariate regression analyses adjusted for age, sex, and BMI * Statistical significance ($p < 0.05$) † association with better outcome

Table 3b Associations between the presence of specific comorbidities and pain, physical functioning, and quality of life in 240 patients following Total Knee Arthroplasty #

		Pain (H/KOOS subscale)			Physical functioning (H/KOOS subscale)			Quality of Life (%) (SF36 **physical** component summary scale)			Quality of Life (%) (SF36 **mental** component summary scale)		
Variabele		mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2
Musculoskeletal disorders													
Severe back pain (hernia included)	present	73.7 (21.9)	-6.0	0.026	69.0 (22.5)	-8.7*	0.038	42.4 (7.6)	.-3.3*	0.059	46.1 (8.2)	-1.2	0.010
	absent	80.5 (20.5)	(-13.3; 1.3)		78.0 (22.4)	(-16.8; -0.6)		46.0 (8.2)	(-6.2; -0.3)		47.8 (7.7)	(-4.1; 1.6)	
Severe neck/shoulder pain	present	74.1 (21.7)	-6.4	0.029	67.8 (24.2)	-11.0*	0.057	42.2 (8.4)	-3.7*	0.069	46.7 (7.4)	-1.0	0.009
	absent	80.5 (20.5)	(-13.5; 0.6)		78.6 (21.6)	(-18.7; -3.4)		46.1 (8.0)	(-6.5; -0.9)		47.7 (7.9)	(-3.7; 1.7)	
Severe elbow, wrist or hand pain	present	73.7 (23.0)	-5.3	0.022	65.3 (24.8)	-12.3)*	0.058	40.7 (9.2)	-5.5*	0.101	45.1 (10.3)	-2.5	0.022
	absent	80.2 (20.3)	(-13.0; 2.3)		78.6 (21.5)	(-20.7; -3.9		46.3 (7.6)	(-8.4; -2.5)		48.0 (7.0)	(-5.4; 0.4)	
Other rheumatic diseases	present	80.2 (19.2)	3.7	0.016	69.4 (23.2)	-6.0	0.022	41.2 (8.6)	-4.5*	0.071	44.7 (10.2)	-3.2	0.028
	absent	78.8 (21.2)	(-5.2; 12.5)		77.1 (22.5)	(-15.8; 3.8)		46.0 (7.9)	(-7.8; -1.2)		48.0 (7.2)	(-6.3; 0.0)	
Non-musculoskeletal disorders													
Asthma or COPD	present	83.3 (22.3)	6.6	0.023	84.0 (20.2)	10.8†	0.039	43.2 (8.8)	-0.5	0.033	48.3 (7.5)	1.4	0.009
	absent	78.3 (20.7)	(-2.3; 15.5)		74.9 (22.8)	(0.7; 20.8)		45.4 (8.1)	(-3.4; 3.3)		47 4 (7.9)	(-2.4; 5.2)	
(Severe) cardiac disorders	present	76.6 (22.5)	-0.2	0.012	76.5 (22.7)	2.8	0.015	45.4 (9.1)	-0.1	0.033	44.1 (9.2)	-4.0*	0.032
		79.2 (20.8)	(-11.0; 10.5)		76.0 (22.7)	(-8.0; 14.5)		45.2 (8.1)	(-4.0; 3.7)		47.9 (7.5)	(-7.7; -0.3)	
Arteriosclerosis in abdomen and legs	present	81.7 (17.4)	3.5	0.014	80.8 (19.7)	2.0	0.014	46.1 (9.5)	0.7	0.033	46.1 (9.5)	-2.2	0.011
	absent	78.8 (21.2)	(-8.9; 15.9)		75.8 (22.9)	(-12.1; 16.0)		47.6 (7.7)	(-4.4; 5.8)		47.6 (7.7)	(-7.0; 2.6)	
Hypertension	present	79.8 (20.5)	2.6	0.016	76.1 (22.4)	1.2	0.015	44.7 (8.3)	-0.3	0.033	47.8 (7.7)	1.1	0.011
	absent	78.2 (21.4)	(-3.5; 8.6)		76.0 (23.1)	(-5.6; 7.9)		45.7 (8.2)	(-2.8; 2.1)		47.1 (8.0)	(-1.3; 3.4)	
(Consequences of) a stroke	present	72.1 (23.5)	-4.9	0.015	75.4 (23.8)	-1.2	0.013	43.3 (6.9)	-1.1	0.034	43.6 (10.1)	-4.3	0.025
	absent	79.5 (20.7)	(-17.2; 7.5)		76.1 (22.7)	(-14.2; 11.9)		45.4 (8.3)	(-6.0; 3.7)		47.8 (7.5)	(-8.8; 0.3)	
Diabetes Mellitis	present	73.2 (25.7)	-7.6	0.029	69.1 (28.7)	-8.9	0.034	43.8 (9.1)	-2.1	0.042	45.3 (9.0)	-3.2*	0.031
	absent	80.0 (19.9)	(-15.9; 0.8)		77.3 (21.3)	(-18.0; 0.3)		45.5 (8.0)	(-5.3; 1.1)		47.9 (7.5)	(-6.3; -0.3)	
Migraine	present	69.9 (25.6)	-6.6	0.019	69.4 (28.0)	-3.4	0.015	41.5 (8.8)	-3.4	0.045	42.0 (10.8)	-5.1*	0.038
	absent	79.7 (20.4)	(-18.4; 5.3)		76.5 (22.3)	(-17.4; 10.5)		45.6 (8.1)	(-7.7; 1.0)		48.0 (7.3)	(-9.2; -0.9)	

Table 3b - Continued

		Pain (H/KOOS subscale)			Physical functioning (H/KOOS subscale)			Quality of Life (%) (SF36 **physical** component summary scale)			Quality of Life (%) (SF36 **mental** component summary scale)		
Variabele		mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2	mean (SD)	B (95% CI)	R^2
Cancer and malignant diseases	present	75.7 (20.7)	-4.3	0.019	74.3 (22.7)	-2.3	0.016	44.3 (8.1)	-0.6	0.034	47.3 (8.5)	-0.4	0.007
	absent	79.9 (21.0)	(-11.8; 3.2)		76.5 (22.7)	(-10.6; 6.0)		45.5 (8.3)	(-3.5; 2.3)		47.5 (7.6)	(-3.2; 2.4)	
Incontinence of urine	present	73.3 (22.2)	-6.0	0.024	68.3 (25.9)	-8.9*	0.036	40 0 (8.5)	-5.9*	0.101	44.2 (8.5)	-3.9*	0.039
	absent	80.2 (20.5)	(-14.0; 2.0)		77.7 (21.7)	(-17.8; -0.1)		46.3 (7.8)	(-9.1; -2.7)		48.1 (7.5)	(-7.0; -0.8)	
Sensory impairments													
Hearing impairments (group conversation)	present	77.4 (20.0)	-3.2	0.020	75.7 (22.1)	-2.0	0.018	44.6 (7.3)	-1.4	0.044	46.9 (7.3)	-1.9	0.029
	absent	79.7 (21.4)	(-8.6; 2.2)		76.2 (23.0)	(-8.1; 4.0)		45.5 (8.6)	(-3.5; 0.7)		47.7 (8.0)	(-3.9; 0.1)	
Vision impairments (short distances)	present	74.9 (21.0)	-2.7	0.017	72.2 (23.4)	.-3.0	0.020	41.5 (7.6)	-3.8*	0.081	42.9 (8.1)	-2.6*	0.034
	absent	79.8 (20.9)	(-8.6; 3.1)		76.8 (22.5)	(-10.0; 4.0)		45.9 (8.2)	(-6.4; -1.3)		48.3 (7.5)	(-5.1; -0.2)	
Vision impairments (long distances)	present	66.1 (20.9)	-7.6	0.029	59.7 (21.7)	-10.7 *	0.044	41.6 (10.3)	-1.8	0.041	47.8 (6.5)	-0.3	0.010
	absent	79.9 (20.7)	(-16.3; 1.1)		77.2 (22.4)	(-20.1; -1.4)		45.4 (8.0)	(-5.3; 1.8)		47.5 (7.9)	(-3.7; 3.0)	
Dizziness in combination with falling	present	63.0 (24.9)	**-15.5***	**0.051**	53.6 (30.4)	**-23.6 ***	**0.066**	41.6 (8.8)	-2.9	0.041	41.9 (8.8)	**-6.4***	**0.048**
	absent	80.4 (20.0)	(-26.8; -4.3)		77.8 (21.1)	(-36.6; -10.7)		45.5 (8.1)	(-7.8; 1.9)		47.9 (7.6)	(-10.9; -1.8)	

For all variables associations are calculated with linear multivariate regression analyses adjusted for age, sex, and BMI * Statistical significance ($p < 0.05$) † association with better outcome

Table 4a Comorbidities included in the final multivariate regression models of the association of comorbidity with pain, physical functioning and health related quality of life in 281 patients undergoing THA

	B	(95% CI)	P-value	R^2
HOOS/ KOOS subscale pain#				
Arteriosclerosis in abdomen or legs	-12.3	(-21.7; -2.9)	0.010	
Dizziness in combination with falling	-12.1	(-23.5; -0.7)	0.037	
Cardiac disorders	-10.6	(-17.6; -3.6)	0.003	0.147
Severe back pain	-8.0	(-14.0; -2.0)	0.009	
Cancer	-6.7	(-12.6; -0.7)	0.028	
HOOS/ KOOS subscale physical functioning#				
Dizziness in combination with falling	-22.0	(-34.2; -9.9)	< 0.001	
Arteriosclerosis in abdomen or legs	-14.9	(-25.3; -4.5)	0.005	
Severe back pain	-12.9	(-19.3; -6.4)	< 0.001	0.215
Asthma or COPD	-9.0	(-16.8; -1.3)	0.023	
Cancer	-8.0	(-14.3; -1.7)	0.013	
SF36 physical component scale†				
Dizziness in combination with falling	-6.4	(12.5; -0.4)	0.037	
Severe back pain	-3.5	(-6.6; -0.4)	0.028	0.094
Incontinence of urine	-3.2	(-6.4; -0.1)	0.045	
Hypertension	-2.9	(-5.3; -0.5)	0.017	
SF36 mental component scale†				
(consequences of) a stroke	-4.8	(-9.0; -0.6)	0.024	0.044
Severe elbow, wrist, or hand pain	-3.2	(-6.2; -0.3)	0.032	

Statistical analyses adjusted for age, sex and BMI

† Statistical analyses adjusted for BMI

Table 4b Comorbidities included in the final multivariate regression models of the association of comorbidity with pain, physical functioning and health related quality of life in 240 patients undergoing TKA

	B	(95% CI)	P-value	R^2
HOOS/ KOOS subscale pain#				
Dizziness in combination with falling	-17.2	(-29.2; -5.2)	0.005	0.068
Vision impairments (long distances)	-12.0	(-24.0; -0.1)	0.049	
HOOS/ KOOS subscale physical functioning#				
Dizziness in combination with falling	-24.4	(-37.4; -11.4)	< 0.001	
Vision impairments (long distances)	-16.9	(-29.2; -4.6)	0.007	0.174
Severe elbow, wrist or hand pain	-9.1	(-17.1; -1.0)	0.028	
Asthma or COPD	12.5	(3.2; 21.9)	0.009	
SF36 physical component scale†				
Incontinence of urine	-4.9	(-8.3; -1.6)	0.004	0.107
Severe elbow, wrist or hand pain	-4.2	(-7.3; -1.1)	0.007	
SF36 mental component scale†				
Diabetes	-3.3	(-6.1; -0.5)	0.006	
Migraine	-4.1	(-8.2; -0.1)	0.046	0.090
Vision impairments (short distances)	-4.3	(-7.3; -1.2)	0.006	

Statistical analyses adjusted for age, sex and BMI

† Statistical analyses adjusted for BMI

In the group of patients who underwent THA statistically significantly more patients were classified as Charnley Class A and significantly less patients classified as Charnley Class C as compared with TKA (p=0.004 and p=0.006 respectively).
Concerning the occurrence of specific comorbidities, hypertension and hearing impairments in a group conversation were the most frequently reported comorbidities (>25% for the total group). Severe back pain; severe neck/shoulder pain; severe elbow, wrist or hand pain; cancer; incontinence of urine; and vision impairment short distances were reported by 15-25% of the patients in the total group.
The occurrence of cancer was significantly lower in the THA group than in the TKA group (38 (13.5%) and 52 (21.7%), respectively (p=0.01)). Regarding all other specific comorbidities there were no differences between THA and TKA.
Table 1 also shows the distribution of the numbers of comorbidities in the total group and the THA and TKA groups. Overall, 86.2% of the patients had one or more comorbidities. The proportion of patients with 5 or more comorbidities was higher in patients with TKA as compared to THA (47 (19.6%) and 37 (13.2%), respectively (p=0.047)).

Associations of the number of specific comorbidities with pain, physical functioning and HRQoL

Table 2a shows that in THA, and adjusted for age, sex and BMI, where appropriate, the presence of 1 or 2 comorbidities was significantly associated with worse physical functioning relative to no comorbidities. The presence of 3 or 4, and ≥ 5 comorbidities was associated with more pain, worse physical functioning and a worse score on the physical component summary scale of the SF 36.
Table 2b shows that in TKA only the presence of ≥ 5 comorbidities was associated with a worse score on the physical component summary scale of the SF 36.

Associations of specific comorbidities with pain, physical functioning and HRQoL

Table 3a shows that in THA severe back pain was statistically significantly associated with worse outcome for 3 out of 4 outcome measures. Arteriosclerosis in abdomen or legs; (consequences of) a stroke; and dizziness in combination with falling were associated with worse outcome for 2 out of 4 outcome measures.
In Table 3b it is shown that in TKA incontinence of urine; and dizziness in combination with falling were associated with worse outcome for 3 out of 4 outcome measures. Severe back pain; severe neck/shoulder pain; severe elbow wrist and hand pain; and vision impairments in short distances were associated with worse outcome for 2 out of 4 outcome measures.

Multivariate regression models with all comorbidities and pain, physical functioning and HRQoL

Table 4a shows the results of the final multivariate regression models for worse outcome in THA for all four outcomes. Comorbidities included in 3 out of 4 of the association models were: dizziness in combination with falling, and severe back pain (associated with more pain, and worse physical functioning and physical component HRQoL). Comorbidities included in 2 out of 4 of the models were severe back pain, and arteriosclerosis in abdomen or legs (associated with more pain, and worse physical functioning).

In Table 4b the results for TKA are shown. Vision impairments (long distances) was included in 3 out of 4 of the association models and associated with more pain, and worse physical functioning and mental component HRQoL. Comorbidities included in 2 out of 4 association models were dizziness in combination with falling (associated with more pain, and worse physical functioning), and severe elbow, wrist or hand pain (associated with worse physical functioning and physical component HRQoL).

Discussion

This study in patients who underwent THA or TKA showed the presence of considerable amount of comorbidities in patients after surgery. Hypertension and hearing impairments in a group conversation had the highest occurrence rates (>25%), while severe back pain; neck/shoulder pain; elbow, wrist or hand pain; cancer; and vision impairments regarding short distances were also relatively frequent as they were reported by 15-20% of the patients.

Some of the present frequencies of the occurrence of specific comorbidities in this study were comparable to earlier studies, i.e. hypertension (42% in THA [12], and 42% in TKA[11]; heart disease (7% in THA[15], 8% in TKA[9]); diabetes (10% in THA[12] and 11% in TKA[11]); COPD (9% in THA[15] and 10% in TKA[9,11]).

The rate of the presence of back pain in the present study was somewhat lower than in earlier studies (37% in THA[11] and 31-35% in TKA[11,16], probably due to the fact that we asked for *severe* back pain only.

In our study an increasing number of comorbidities was associated with worse outcome. This observation appeared to be somewhat stronger in THA than in TKA. This finding was also seen for HRQOL and/or or physical functioning in studies by Rat et al[18] and Stevens et al[17], concerning THA and TKA plus THA, respectively. Perrucio et al[14] reported more pain and worse physical functioning with increasing joint counts in TKA. This is in some extent comparable with our study, in which multiple sites of joint involvement were included as specific comorbidities. However, no good comparisons can be made since no specified analyses for other impaired joints were conducted in our study.

The present study focused on 19 different comorbidities. Considering all comorbidities separately dizziness in combination with falling being most consistently associated with worse outcomes in both THA and TKA. In THA severe back pain was associated with pain, physical functioning, and the physical component of HRQoL. The presence of arteriosclerosis in abdomen or legs was associated with pain and physical functioning. In TKA the presence of severe back pain, neck/ shoulder pain, elbow, wrist or hand pain, and incontinence of urine were associated with physical functioning and the physical component of HRQoL. From models including all comorbidities, it appeared that in THA dizziness, severe back pain were associated with 3 out of 4 outcomes, while in TKA dizziness and vision impairments (long distances) and severe elbow, wrist and hand pain were associated with 2 out of 4 outcomes.

The most prominent presence of dizziness in combination with falling is difficult to compare with presence in other studies, as these studies did not include this comorbidity. Dizziness has however been previously identified as one of the main reasons for a longer stay in hospital after surgery[32] and can be related to presence of anaemia, which is related to worse outcome in hip fracture patients.[14] Severe back pain was also consistently associated with adverse outcomes in THA. This finding is in contrast with the results from the study by Novicoff et al[19] in which this association was found in TKA.

In our study, obesity was not considered as a specific comorbidity, but rather as an influential factor. Therefore BMI was included in all analyses. The literature shows conflicting evidence regarding the association of obesity with complications[33] after surgery. Regarding physical functioning there seems to be no difference in outcome between obese and non-obese patients. Only morbidly obese patients (BMI > 40) were found to be at a greater risk for perioperative complications such as infection and revision than patients with a BMI < 40, most likely due to the additional other existing comorbidities (i.e. diabetes, hypertension and cardiac diseases).[34] On the other hand, obesity can be considered as a contraindication by orthopaedic surgeons in their decision to start surgery based on the ASA criteria, leading to a probable underestimation of their influence on postsurgical outcome. It remains unclear to what extent this occurred in our study, as the frequency of morbid obesity (BMI>40) only 1% in our study population.

This study has a number of limitations. First, only 4 hospitals in a specific area in the Netherlands were involved, the sample size was limited, the response rate moderate (52%), and no comparison is made with non-responders. Therefore results cannot be generalized to all patients undergoing THA or TKA. However, based on baseline characteristics, it seems to be a representative sample of this patient group. Furthermore the study is cross-sectional and not longitudinal, which makes that only associations can be determined, and no predictions can be made. All the data were gathered by patient self-reported questionnaires. Examination of the medical records could probably have given more reliable and additional information, however this very time consuming method could not be used in the framework of this study. Finally, the retrospective

design of this study can make the responses of the, predominantly elderly participants (mean age 70 years), probably less reliable. Therefore, conclusions must be made with caution.

Despite these limitations, this study taking a large number of comorbidities into consideration and analysing THA and TKA patients separately, found that not only the number of comorbidities but also their nature are related to the outcomes. In particular dizziness in combination with falling plays a consistent role in both THA and TKA, and severe low back pain in THA. But on top of that all, other comorbidities, except for hypertension, are to some extent related to the outcomes of THA and TKA. This underlines the need to take the presence of specific comorbidities into account in daily practice after patients underwent surgery. The present study showed that probably a broad range of specific, individual comorbidities needs to be taken into account during the recovery and rehabilitation period after surgery. The presence of comorbidity is one of the reasons of unfavourable outcome after surgery.[4] The presence of severe back pain as in this study should be ascertained before surgery and treated if possible, since the predictive value is confirmed in earlier studies.[35] Although not yet confirmed in a prospective study, the presence of dizziness in combination with falling should maybe taken into account before surgery as well.

Currently, the ASA classification[24] is used preoperatively, but this is mainly aimed at the selection of patients regarding their risk to undergo surgery, and not with respect to their risk of adverse functional outcomes. With respect to the latter, the Charnley classification is a commonly used instrument[25,26], but it does not distinguish clearly between musculoskeletal and non-musculoskeletal conditions. Detecting the presence of more specific comorbidities seems to be of additional value.

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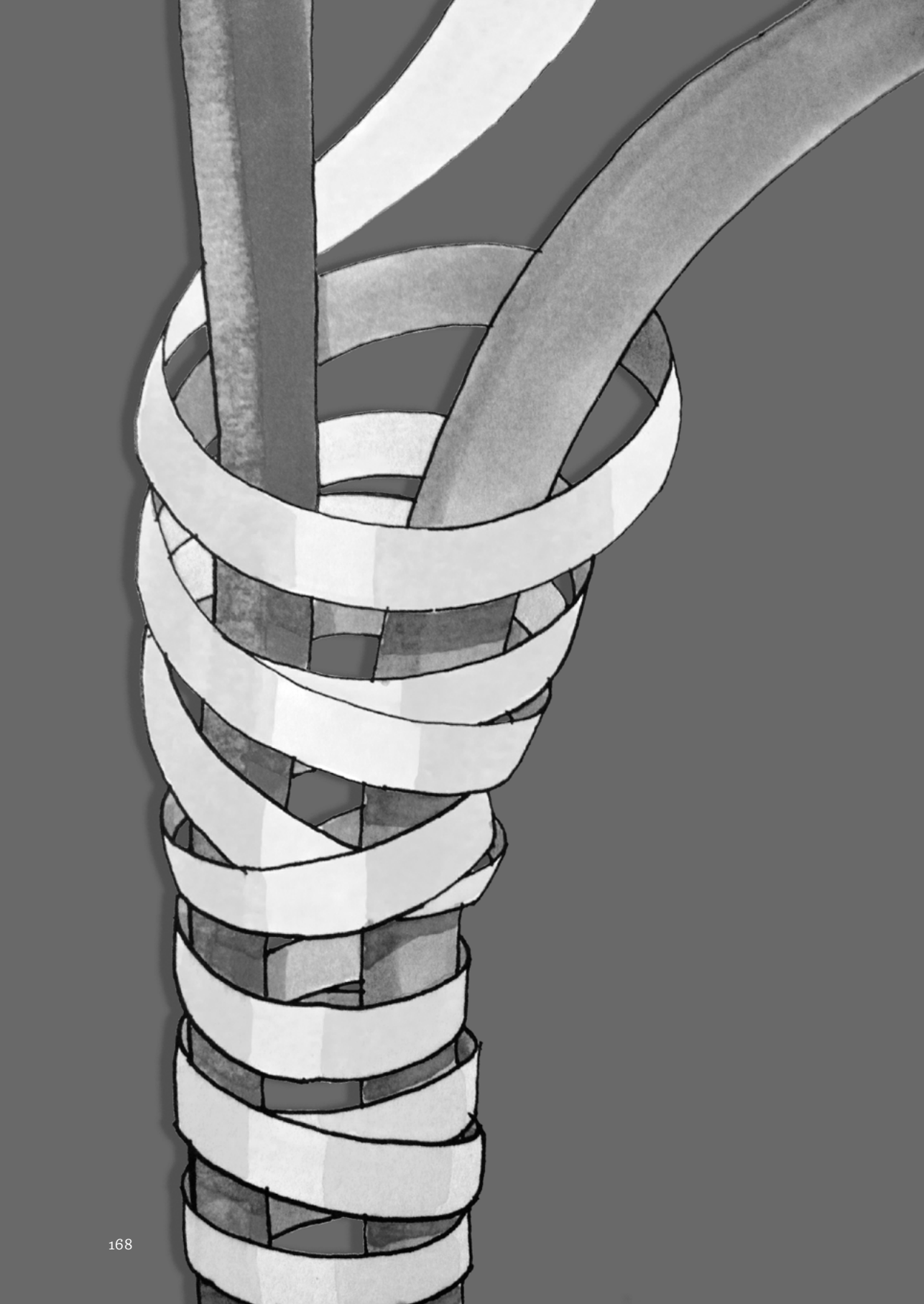

Chapter 9

Summary and General Discussion

Summary

Osteoarthritis (OA) of the hip or knee is one of the most prevalent joint disorders, causing pain and disability[1], and constituting a significant socio-economic burden for society.[2] Physiotherapy (PT) is one of the cornerstones of the conservative management of patients with hip and knee OA .[3] Moreover, in end-stage hip and knee OA, total joint replacement surgery is a very effective treatment option, with an important role for PT in the rehabilitation phase .[4-6]

The effectiveness of PT, both in the conservative as the surgical management of hip and knee OA, is substantiated by the literature. However, to improve the quality of PT care in daily practice, it is necessary to summarise the evidence and translate it into practice recommendations. Then, active implementation strategies are needed to enhance the uptake of such recommendations by professionals.

In **Chapter 2** of this thesis the development of an update of the Dutch PT guideline for hip and knee OA, and an overview of the resulting recommendations for daily clinical practice are presented.

A guideline steering committee, comprising 10 expert physiotherapists (PTs), selected topics concerning the three guideline chapters: initial assessment, treatment and evaluation. With respect to treatment, a systematic literature search was performed, using various databases, and the resulting evidence was graded. Based on this evidence and on expert opinion, recommendations were formulated.

The updated guideline comprised eleven topics. For the chapter initial assessment, these topics concerned the following three aspects: history taking, red flags, and formulating treatment goals. With respect to the chapter treatment, five topics included recommended treatment modalities: (supervised) exercise therapy; education and self-management interventions; a combination of exercise and manual therapy; postoperative exercise therapy; and taping of the patella in combination with strengthening and functional exercises. In addition, one topic concerned the following treatment modalities which were neither recommended nor discouraged: balneotherapy; 'passive' hydrotherapy; thermotherapy; Transcutaneous Electrical Nerve Stimulation (TENS); and Continuous Passive Motion (in knee OA). Moreover, one topic concerned not-recommended treatment modalities: massage therapy; ultrasound; electrotherapy; electromagnetic field therapy; Low Level Laser Therapy; and preoperative PT and education. Finally, one topic concerned the chapter evaluation, for which the following measurement instruments were recommended: Lequesne index; Western Ontario and McMaster Universities osteoarthritis index (WOMAC) or the Hip disability and Osteoarthritis Outcome Score (HOOS) or Knee injury and Osteoarthritis Outcome Score (KOOS); 6-minute walk test; Timed Up and Go test; Patient Specific Complaint list; Visual Analogue Scale (VAS) for pain; Intermittent and Constant OsteoArthritis Pain questionnaire (ICOAP); goniometry; the Medical Research Council scale for manual testing of

muscle strength; and a handheld dynamometer for muscle strength. Treatment should preferably be evaluated by using a combination of a self-reported questionnaire and a performance-based test.

For the evaluation of the uptake of guidelines by professionals, appropriate measurement instruments are needed. A common way to measure quality of care is the use of quality indicators (QI) derived from professional guidelines.[7,8] QI derived from professional guidelines usually concern mainly process indicators, and to a lesser extent structure or outcome indicators.

Chapter 3 describes the development of a set of process QI derived from an updated version of a PT guideline for the management of hip and knee OA. First, 41 guideline recommendations were rated for their relevance by an expert panel of PTs, transformed into potential indicators and incorporated into a questionnaire, the Quality Indicators for PT in Hip and Knee Osteoarthritis (QIP-HKOA). Adherence with each indicator was rated on a Likert scale (0 = never to 4 = always). The QIP-HKOA was then administered to groups of expert PTs (n=51) and general PTs (n=134), with the aim to test its discriminative power.

QIP-HKOA items were included in the final set if they were in general considered to be related to the cornerstones of PT in hip and knee OA (exercise therapy and/or education), were significantly different between expert and general PTs, and/or were followed by <75% of PTs in both groups.

Following these requirements, an 18-item QIP-HKOA [score range 0-72] was developed. Twelve indicators were considered to be the cornerstones of PT care; six indicators had discriminative power and/or were followed by <75% PTs in both groups. The resulting QIP-HKOA score was significantly higher among experts (60.73; standard deviation (SD) 5.67) than among general PTs (54.65; SD 6.17) ($p < 0.001$). Reliability was tested in a subgroup of 46 PTs by computing the intraclass correlation coefficient (ICC), which was 0.89. In conclusion, the QIP-HKOA, based on 18 process indicators derived from a revised PT guideline on hip and knee OA, was found to be reliable and discriminated between the adherence with guideline recommendations among expert and general PTs. Its ability to measure improvements in the quality of PT care within PTs or PT practices or discriminate among PTs and PT practices needs to be further examined.

As mentioned before, the aim of guidelines is to improve the quality of care, nevertheless unsatisfying adherence to clinical guidelines has often been reported.[9-13] Thus, the use of active implementation strategies, in addition to passive dissemination, has been recommended.[9-12] However, little is known on the most effective implementation strategies to improve adherence with PT guidelines on the management of OA. The standard method in the Netherlands is organising lectures about the theme of the guideline, in addition to passive guideline dissemination (distribution by regular mail and making it available on the website of the professional organisation). In addition to these existing

interventions, in the context of this thesis an interactive workshop was developed. This interactive workshop consisted of a presentation of a summary of the guideline, discussion about the topics in the guideline, practicing the application of measurement instruments, and demonstrating relevant exercises. For this purpose, 3 patients participated in the workshop (i.e. patient-partners). Discussions were done according to the process of clinical reasoning.

Chapter 4 describes a study comparing this interactive workshop (IW) with the conventional educational intervention (CE) regarding the revised guideline on hip and knee OA. In that study, PTs from three regions in the Netherlands were invited, and participants were randomly assigned to one of the two courses. Satisfaction with the course (scale 0-10), guideline adherence (score range 0-72), and knowledge (score range 0-76) were measured at baseline, immediately after the educational course and 3 months thereafter.

In total, 203 (10%) PTs participated in the IW group (n = 108) and the CE group (n = 95). There were no differences between groups at baseline. After the course, satisfaction was significantly higher in the IW than in the CE group [mean scores (S.D.) 7.5 (1.1) and 6.7 (1.6), respectively (P<0.001). A significantly greater improvement in adherence measured with the QIP-HKOA was seen over time in the IW group compared with the CE group (F=3.763, P=0.024), whereas the difference in improvement of knowledge measured with a guideline-derived self-developed questionnaire was not statistically significant (F=1.283, P=0.278).

After the study presented in **Chapter 4** was completed, the interactive educational course was carried out in three regions in the Netherlands. To further implement the guideline nationwide, six other regions in the Netherlands were offered to give the interactive educational course to PTs. **Chapter 5** describes an additional study in which PTs were randomly allocated to the 3-hour interactive educational course with the collaboration of 3 patient-partners, or no intervention (waiting list). For the evaluation, adherence with the guideline was assessed using the six items (score range 0-24) from the QIP-HKOA which were previously found to discriminate between general and expert PTs (**Chapter 3**). In addition, questionnaires regarding knowledge (score range 0-76), and barriers to use the guideline (score range 0-80) were used. Assessments were conducted 1 week before the interactive course (T0) immediately after (T1), and 3 months thereafter (T2). In the six regions 284 of 4328 eligible PTs (7%) were included. The intervention (n=133) was significantly more effective than no intervention (n=151) concerning self-reported adherence and knowledge with mean differences in change scores (95% CI) at T1 and T2 being 1.4 (0.7-2.0) and 0.9 (0.2-1.7) for adherence and 6.8 (4.5-9.1) and 3.9 (1.7-6.2) for knowledge, (all p-values <0.005). In both groups the barrier score increased at T1 and decreased at T2, with a significantly larger increase at T1 and decrease at T2 in the intervention group (mean differences 3.1 (1.8-4.4) and 3.3 (0.5-6.1), respectively.

In conclusion, a short interactive educational course with patient participation regarding a revised PT guideline on hip and knee OA showed a small to moderate positive effect on self-reported guideline adherence and knowledge, whereas for perceived barriers an advantage was only seen at the long term follow-up.

The Dutch PT guideline described in **Chapter 2** also comprised recommendations regarding PT after joint replacement surgery in patients with hip and knee OA. However, little is known about the extent to which these recommendations are currently used in daily PT practice. **Chapter 6** describes the usage and characteristics of postoperative PT according to PTs. For that purpose, an online survey was sent to a random sample of 957 Dutch PTs. The survey included questions on the application of treatment modalities (yes/no) recommended, neither recommended nor advised against, or advised against and some treatment modalities for which no recommendations had been formulated. A total of 219 PTs (response 23%) completed the questionnaire, with a mean age of 40 years (sd 12.6 yrs), 55% being female and 95% working in primary care. The vast majority reported the use of the recommended exercise modalities (muscle strengthening exercises (96%), and functional exercises (99%)). Continuous passive motion, which was neither recommended nor advised against, and electrical muscle stimulation, which was not recommended, were provided by 1%. Treatment modalities which were reported by >10% of PTs, but for which there were no concrete recommendations formulated in the guideline included patient education (99%), gait training (95%), active range of motion (ROM) exercises (93%), balance exercises (86%), passive ROM exercises (58%), aerobic exercises (50%), massage (18%) and cold packing therapy (11%).

In conclusion, the vast majority of PTs reported adhering to recommendations on post-acute postoperative PT in total hip and total knee patients after discharge from hospital. Although yet to be confirmed in a larger nationwide survey, the relatively high frequency of the use of many other treatment modalities, for which there were no formulated recommendations, suggests that there is a need to extend the current set of recommendations regarding the post-acute, postoperative PT treatment in patients with hip and knee OA who underwent joint replacement surgery.

Reports on the provision of PT before and after joint replacement surgery from the perspective of the PT, as described in the previous chapter are scarce, but yet available.[14,15] Reports from the patient perspective are less often published. Besides that, much studies lack detail regarding the provision of different treatment modalities and/or are not on the level of the individual patient. To get more insight into the usage and characteristics of preoperative and postoperative PT from the patients' perspective, **Chapter 7** describes a multicenter survey among 522 patients with hip or knee OA undergoing joint replacement surgery.

A total of 1005 patients in four hospitals who underwent total hip arthroplasty (THA) or total knee (TKA) arthroplasty in the previous year were sent a survey comprising

questions regarding referral, setting, duration and content of preoperative PT and postoperative PT as well as sociodemographic characteristics, comorbidity, physical functioning and health related quality of life. In addition, the impact of age, sex, time since surgery, and hospital on features of PT was studied. The response rate was 52% (282 THA, 240 TKA), with 337 (65%) women, mean age 70.0 years (SD 9.3). Almost all persons (98%) had received postoperative PT and 40% preoperative PT. There was a considerable variation of provided treatment modalities, in particular before surgery. Referrals were made by orthopaedic surgeon in 31% of persons who had preoperative PT and in 77% of persons who had postoperative PT. Duration of PT was > 12 weeks in 44% and 47% of persons who had preoperative PT and postoperative PT, respectively. Most frequently reported treatment modalities (>60% of persons) for preoperative PT were aerobic exercises and walking stairs, whereas for postoperative PT aerobic, muscle strengthening and range of motion exercises, walking stairs, and gait training were most frequently reported in THA and/or TKA. Some of the reported features of PT were associated with age and sex of the participants, the time since surgery, and the hospital.

Interpretation of the results should be done with caution due to the retrospective nature of the study, carried out in a specific area in the Netherlands. Observed practice variation regarding the provision of preoperative PT and, to a lesser extent, postoperative PT, warrant the need for future, prospective research aimed at the optimisation of PT delivery related to THA and TKA.

The survey described in Chapter 7 included the presence of comorbidity in the patients, as a factor probably related to the use of PT. As comorbidity was found to be associated to unfavourable outcomes in patients undergoing THA and TKA16, Chapter 8 describes the associations between number and specific comorbidities with clinical outcome approximately one-two years after surgery in 521 patients. This cross-sectional survey included 19 specific comorbidities, and was administered in patients who underwent THA and TKA in the previous 7-22 months in one of four hospitals. Clinical outcome measures included pain, physical functioning, physical and mental Health Related Quality of Life (HRQoL).

Of the 521 patients (281 THA and 240 TKA) included, 449 (86%) had ≥1 comorbidities. The most frequently reported comorbidities (>15%) were: severe back pain; neck/shoulder pain; elbow, wrist or hand pain; hypertension; incontinence of urine; hearing impairment; vision impairment; and cancer. Only the prevalence of the latter was significantly different between THA (n=38; 14%) and TKA (n=52; 22%) (p=0.01). An increasing number of comorbidities was more strongly associated with worse outcomes in THA than in TKA. In multivariate analyses including all comorbidities with a prevalence of >5%, the presence of dizziness in combination with falling and severe back pain in THA, and dizziness in combination with falling and vision impairments (in long distances) in TKA, were most consistently associated with worse clinical outcomes.

In conclusion, a broad range of specific comorbidities needs to be taken into account to make an accurate prediction of the postoperative functional outcome. Specifically the presence of dizziness in combination with falling in THA and TKA, severe back pain in THA, and vision impairments in TKA should be ascertained before surgery, and if present be treated if possible in order to decrease the chance of an unfavourable outcome.

Discussion

This thesis focuses on PT in patients with hip and knee OA. It describes the development of a revised Dutch PT guideline on the management of patients with hip and knee OA, which included a set of quality indicators (QI) to measure adherence to guideline recommendations in daily practice as a proxy for quality of care. Concerning the active implementation of this guideline, an interactive postgraduate educational course was evaluated concerning its effectiveness, and subsequently implemented on a larger scale. In addition, the delivery of PT before and after joint replacement surgery, both from the perspective of the PT and of the patient, was described. Finally, the presence and the influence of comorbidity on outcome after surgery, all based on patient report, was investigated.

The updated PT guideline for the management of hip and knee OA was based on both recent scientific evidence as well as expert opinion, and was developed according to standardized procedures for formulating recommendations.[17] It described the process of initial assessment, PT interventions and various measurement instruments that can be used to evaluate treatment.

In addition to updating research evidence, there are some aspects that can be improved in future updates of the guideline. First, the number of patients involved in the guideline development process can be increased. The European League Against Rheumatism (EULAR) recommends that a minimum of two patient research partners should be involved in each research project from start to finish.[18] In the current guideline development process feedback on the draft version of the guideline was obtained from only one patient and one representative from a patient organization. This recommendations may be applicable to other guidelines on the management of hip and knee OA as well, as, according to the descriptions of the guideline development processes, no patients were involved in the guideline working group of e.g. the guideline for knee OA of the American Academy of Orthopaedic Surgeons (AAOS)[19], a guideline on the total hip replacement[20] and a draft guideline regarding total knee replacement of the Dutch Orthopaedic Association (Nederlandse Orthopaedische Vereniging; NOV)[21].

Second, regarding the treatment modalities, more details concerning the characteristics and content of the interventions should be described in the recommendations, such as the frequency, duration and intensity. For that purpose, frameworks for the

optimisation of the reporting of PT interventions can be used. An example is the framework developed by van der Leeden et al.[22] in the context of the DO-IT (Designing Optimal Interventions for physiotherapy) program. DO-IT is a research program of the Royal Dutch Society for Physiotherapy (KNGF) aiming to design optimal PT interventions in patients with chronic disorders, including frail elderly, cystic fibrosis, COPD and knee osteoarthritis. Sufficient and unambiguous descriptions from research projects are a prerequisite for a proper execution of exercise interventions into daily clinical practice. How the quality of delivery of PT can impact outcomes is illustrated by a recent study from Knoop et al[23], in which the execution of two precisely described exercise programs in knee OA was intensively monitored, resulting in a larger effect of exercise therapy than in earlier studies.

Third, in light of the growing number of total joint replacement surgeries in hip and knee OA, and the important position of PT in the rehabilitation process of care in these patients, more recommendations regarding PT interventions before and after surgery are needed.

In the evidence-based guideline for knee OA of the AAOS[19] and the guideline on the total hip replacement of the NOV[20], no details regarding rehabilitation were described. Only a draft guideline regarding total knee replacement of the NOV[21] provides some details on physiotherapy treatment, but refers to an initiative for a guideline specifically on PT in total hip and knee arthroplasty that is taken in the Netherlands (the Royal Dutch Society for Physical Therapists (KNGF) and Central Quality Institute for Health Care (CBO); personal communication). Internationally, to our knowledge, only one expert based consensus statement regarding best practice for post-acute rehabilitation after total hip and knee arthroplasty, has been published by Westby et al.[24]

In **Chapter 3** the development of a set of QI, in the form of a questionnaire for PTs is described. Overall, there is a lack of QI specifically for PT, especially in OA. The QI for PT in hip and knee OA which were available at the time the studies in this thesis were conducted were part of multidisciplinary QI sets and described in relatively little detail[25,26], were not developed according to international guidelines for QIs[17], or were based on an older version of a guideline.[27] For these reasons, they were not completely suitable to measure, monitor and compare the quality of PT in hip and knee OA in current daily practice.

The set of process QI developed from the update of a Dutch physiotherapy guideline on hip and knee OA (QIP-HKOA) provided more detailed information on PT care. However, there is still room for improvement regarding the developmental process. Until recently, instruments to appraise the developmental process of QI were scarce. In the Netherlands the so-called AIRE (Appraisal of Indicators through Research and Evaluation) instrument was developed[28], and used in some studies[29,30], but its validity has

not been confirmed. Recently, another instrument to measure the quality of QI was developed and has become available on the internet: the Appraisal of Guidelines for Research & Evaluation (AGREE) II QI.[31-34] It can be used as a checklist to develop QI or retrospectively review the quality of the developmental process. The AGREE II QI has already been used in cardiovascular care.[35] According to the AGREE II QI, the QI development group should be multidisciplinary, the set of indicators should cover different aspects of clinical care, such as patient specific goal setting, and should be applicable to the level of the individual patient. Preferably they should be quantifiable, by using a numerator and a denominator. The set of QI in the QIP-HKOA developed in the context of this thesis does not fulfil all of these requirements. Examples of QI for the management of OA which better comply with these standards are those recently developed in the EUMUSCNET project (http://eumusc.net/workpackages_wp6.cfm).[36]

All of the abovementioned sets of QI aim to measure the quality of care by obtaining information from health care providers. Information on the quality of care can however also be obtained from other sources, such as the patients. Regarding the quality of OA care specifically, a set of QI to be completed by patients was recently developed and pilot tested.[25]

To improve the quality of care in general, the value of professional guidelines is commonly acknowledged. However, adherence with guidelines is suboptimal, and are recommended to enhance their uptake active implementation strategies.[8-11] The provision of educational courses is a common option, and therefore the focus of **Chapters 4 and 5** of this thesis. These chapters show that the provision of an interactive postgraduate education was more effective and preferred by PTs compared to a conventional lecture about the guideline. It appeared that the collaboration of patients in the course supported its effect, an observation done in earlier studies as well.[37,38] However, the effect of the course on the reported adherence with the guideline was relatively small. This is probably due to the relatively short duration of the educational course (i.e. once for 3 hours). Extension of the course would probably yield a larger effect. In addition, it is questionable whether the instruments we applied to measure the effectiveness of the educational intervention, were most appropriate, and cover all aspects of outcome. According to the Kirkpatrick model, evaluations of education should comprise reaction of students, learning aspects, change in behaviour, and results.[39,40] In particular the latter aspect was lacking in our evaluation.

Moreover, with the educational courses we reached only a minority (estimated proportion approximately 5%) of PTs in the Netherlands. The development of online courses could probably increase the outreach. However, in that case, technical solutions to guarantee appropriate interaction of students with the tutors and patients are needed. Making educational courses related to professional guidelines mandatory in the process of registration and re-registration of health care providers could also be a strategy to enhance participation.

Implementation of guidelines through education of professionals is one strategy. Other strategies can be used on the level of the organisation or the patient. To inform the patient about the existence of the guideline and the relevance of its recommendations for their own situation, the availability of educational materials for patients is a potential strategy. Currently, the European League Against Rheumatism (EULAR) and European Federation of Orthopaedics and Traumatology (EFORT) are taking the initiative to develop recommendations for the dissemination of professional guidelines to patients [personal communication]. Moreover, the Dutch Orthopaedic Association (NOV) has educational material available for patients, both in print (www.zorgvoorbeweging.nl) as well as at the internet (www.orthopedend.org ; and www.mijnbesteheup.nl).
Other examples targeted at patients include the care booklet hip and knee osteoarthritis (Zorgwijzer Heup en Knieartrose)[41], developed in the context of the BART (Beating osteoARThritis) project.[42,43]
The update of the guideline on the PT management of hip and knee OA also included recommendations on the preoperative and postoperative PT treatment in case patients underwent joint replacement surgery. However, only a few recommendations were formulated, concerning muscle strengthening exercises, functional exercises, and Continuous Passive Motion [CPM]. The surveys among patients (**Chapter 7**) and PTs (**Chapter 6**) showed that in daily practice also other interventions, for which no recommendations had been defined, were relatively often provided. This observation would warrant the development of more detailed recommendations on PT related to total joint replacement surgery, a process that has already started in the Netherlands, with the institution of a multidisciplinary working group, and a systematic research strategy.
In addition, it is noteworthy that more than 40% of patients who had a total hip or total knee replacement reported to have had preoperative PT (**Chapter 7**). This is striking as, in contrast with postoperative PT, no evidence for the effectiveness of preoperative PT is available. It could be hypothesized that the patients receiving preoperative PT concerned a subgroup of so-called "high-risk" patients, with e.g. comorbidities. Indeed, the update of the Dutch PT guideline mentions to consider preoperative PT in case of patients with a low functional status, such as the presence of multiple comorbidities (**Chapter 2**). In addition, in a recently published statement for preoperative and postoperative PT in frail elderly with hip and knee OA from the KNGF[41], it is recommended that in patients with a certain level of risk factors for poor outcome, preoperative PT should be given, although this could not be substantiated by evidence in literature. However, a comparison of patients who did and who did not receive preoperative PT in the cohort described in **Chapters 7 and 8**, did not substantiate all of the abovementioned hypotheses. No differences were seen between patients who did and who did not receive preoperative PT, except that women more frequently received preoperative PT. In that population the average BMI was 27.8, and another risk factor, a Charnley-score B/C, as a measure for existing comorbidity, was present in 75.2% of patients. This suggests that probably the large majority of these patients would be classified as being at an increased risk of a worse outcome and therefore in need of preoperative PT. In conclusion, at present, no evidence is available to what extent physicians, PTs and/or patients use the presence of comorbidities as a part of the decision making to provide or seek PT treatment before surgery.

Making an appropriate inventory of the number and nature of *specific* comorbidities before surgery (**Chapter 8**) could be helpful in the selection of 'high risk' patients, since in our study particularly the presence of five or more comorbidities appeared to be associated with poor outcome after surgery. The same was true for the presence of specifically severe back pain, dizziness in combination with falling, and vision impairments (long distances). These conditions should probably be better identified , and if present be treated before surgery, if possible.
Furthermore, one of the risk factors in the Dutch evidence based statement on preoperative PT[44], a BMI > 25, seems to be a factor present not only in a considerable proportion of people in the studies in this thesis, but also in society as a whole. Its role in the outcome of total hip and knee arthroplasty is however debatable, as a review[45] found conflicting evidence regarding the association of obesity with complications after surgery, and only morbidly obese patients (BMI > 40) were at greater risk. It can be concluded there is a need for more research on detecting subgroups of patients at high risk for poor outcome, and the effect of preoperative PT in this specific group on postsurgical outcome.

Regarding postoperative PT we found a large variation in the provided treatment modalities reported by PTs (**Chapter 6**), as well by patients (**Chapter 7**).
So far only Westby et al[24] have published an expert-based consensus on post-acute rehabilitation after hip and knee arthroplasty. The observed practice variation underlines the need to underpin more interventions than those currently included in the Dutch guideline with evidence and expert opinion. Recommendations should probably be formulated separately for THA and TKA, since TKA patients are in general more often obese, and these TKA patients are more prone to have an unfavourable outcome after surgery as compared to THA patients (**Chapter 8**). Moreover, in daily practice there appeared to be some differences in the provided treatment modalities between THA and TKA patients (**Chapter 7**). More research regarding effective treatment strategies and the formulation of recommended treatment modalities in postoperative PT for hip and knee separately, but also for treatment modalities that cannot be recommended, should be undertaken, in order to improve PT management in daily practice in hip and knee osteoarthritis patients undergoing joint replacement surgery.

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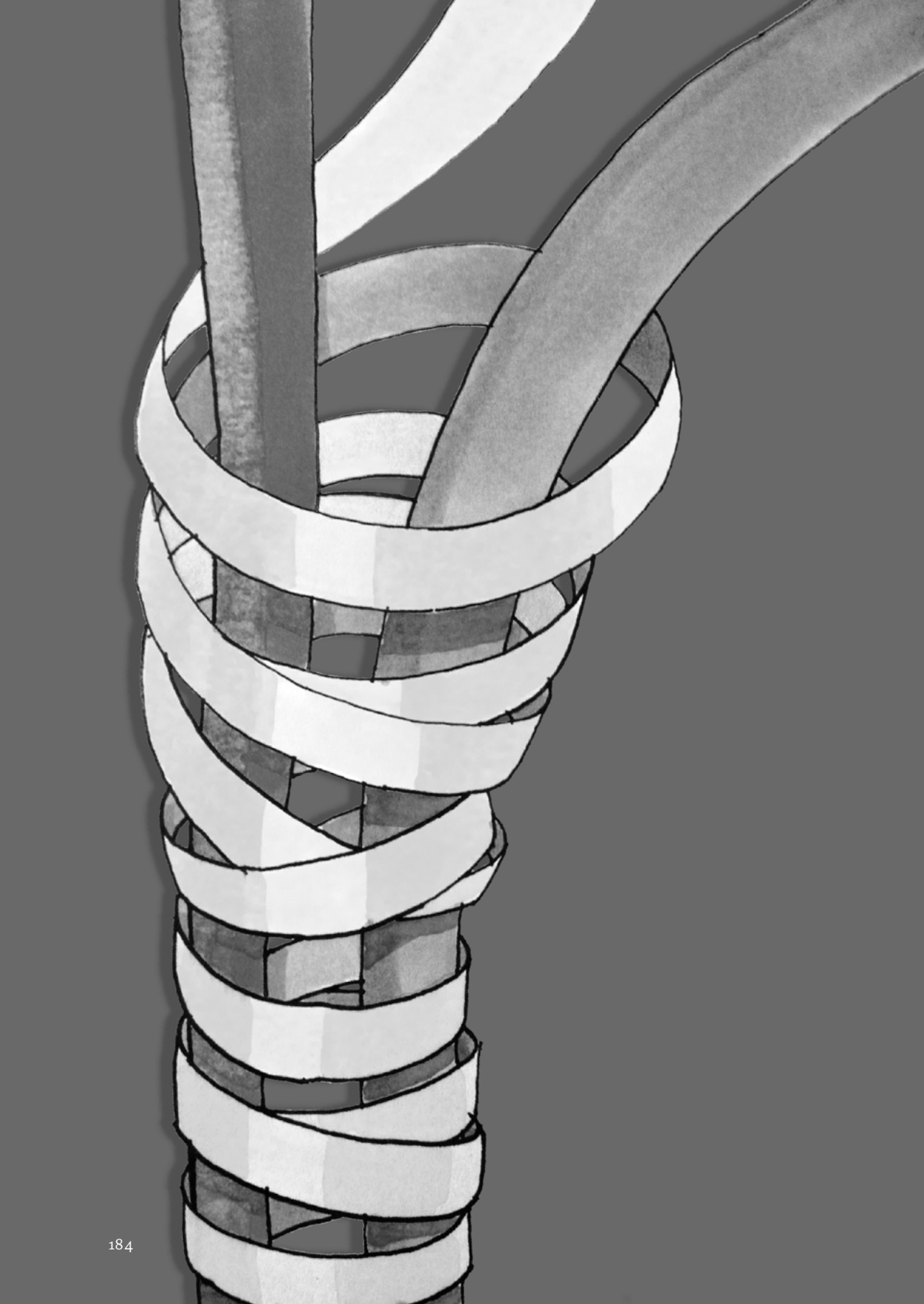


Chapter 10

Nederlandse Samenvatting

Samenvatting

Artrose van het heup- of kniegewricht is één van de meest voorkomende aandoeningen van het bewegingsapparaat. Heup- of knieartrose gaan gepaard met pijn, stijfheid en met beperkingen bij lichamelijke activiteiten en de maatschappelijke participatie. Naast de gevolgen op het niveau van de individuele patient is ook de impact van deze aandoening op de gezondheidszorg en de maatschappij aanzienlijk. Fysiotherapie is één van de basiselementen in de conservatieve (niet-chirurgische) behandeling van heup- en knieartrose. Ook bij de behandeling van patiënten die een gewrichtsvervangende operatie van de heup of de knie ondergaan als gevolg van artrose, speelt fysiotherapie een belangrijke rol.
Het effect van fysiotherapie, zowel in de conservatieve behandeling als in het revalidatieproces rond een gewrichtsvervangende operatie, wordt beschreven in de wetenschappelijke literatuur. Echter, om de kwaliteit van de fysiotherapeutische zorg in de dagelijkse praktijk te verbeteren, is het noodzakelijk om de bewijskracht samen te vatten en te vertalen naar aanbevelingen voor de praktijk. Vervolgens is inzicht in de huidige praktijk nodig, en zijn actieve implementatie-strategieën aangewezen om het gebruik van de aanbevelingen in de dagelijkse praktijk door professionals te bevorderen. Dit proefschrift richt zich op alle bovengenoemde aspecten van fysiotherapie bij heup- en knieartrose.

In **hoofdstuk 2** van dit proefschrift wordt de ontwikkeling van de herziene fysiotherapie richtlijn van het Koninklijk Nederlands Genootschap voor Fysiotherapie (KNGF) voor de behandeling van patiënten met heup- en knieartrose beschreven. Deze richtlijn biedt aanbevelingen voor onderzoek, behandeling en evaluatie van patienten met heup- en knieartrose in de dagelijkse fysiotherapeutische praktijk. De aanbevelingen zijn geformuleerd op basis van bewijskracht uit de literatuur en de mening van deskundigen op het gebied van heup- en knieartrose.
Om de toepassing van de aanbevelingen in de richtlijn in de dagelijkse praktijk te evalueren zijn geschikte meetinstrumenten nodig. Om deze reden worden vaak kwaliteitsindicatoren uit richtlijnen afgeleid. Kwaliteitsindicactoren zijn meetbare elementen van zorgverlening die aanwijzingen geven van de kwaliteit van de zorg en kunnen betrekking hebben op zowel de structuur, het proces als de uitkomsten van zorg.
Hoofdstuk 3 beschrijft de ontwikkeling van een set van procesindicatoren afgeleid van de herziene versie van de KNGF-richtlijn Artrose Heup en Knie. Er werd een set van 18 indicatoren ontwikkeld, die vervolgens werden omgezet in een vragenlijst, de zogenaamde Quality Indicators for Physiotherapy in Hip and Knee Osteoarthritis (QIP-HKOA). Daana werd de geschiktheid van de QIP-HKOA, als instrument om het volgen van de aanbevelingen in de richtlijn te meten getest. Op grond van een onderzoek waarin 51 gespecialiseerde en 134 algmemene fysiotherapeuten waren betrokken, kon worden vastgesteld dat de QIP-HKOA een betrouwbaar meetinstrument was, en in staat om onderscheid te maken in de mate van het volgen van aanbevelingen in de richtlijn tussen in artrose gespecialiseerde fysiotherapeuten en algemeen fysiotherapeuten. Of de QIP-HKOA in staat is om verbeteringen in kwaliteit van zorg te meten binnen individuele fysiotherapeuten of praktijken of vergelijkingen tussen fysiotherapiepraktijken te kunnen maken dient nog verder onderzocht te worden.
Zoals eerder gezegd is het doel van het ontwikkelen van richtlijnen kwaliteitsverbetering van de zorg. Desondanks wijzen onderzoeken uit dat het gebruik van richtlijnen in de dagelijkse klinische praktijk tegenvalt. Daarom wordt aanbevolen om actieve implementatiestrategieën te gebruiken, als aanvulling op het (passief) verspreiden van richtlijnen onder professionals in de zorg. Tot nu toe is er weinig bekend over welke implementatiestrategie het meest effectief is om het gebruik van richtlijnen met betrekking tot artrosezorg te bevorderen. In Nederland is het gebruikelijk om richtlijnen onder fysiotherapeuten te verspreiden door middel van het versturen per post, het beschikbaar stellen via internet en het geven van lezingen. In het kader van dit proefschrift werd in plaats van de conventionele lezing een nascholing bestaande uit een interactieve workshop ontwikkeld. Deze workshop bestond uit een korte presentatie van de inhoud van de richtlijn, discussies over een aantal belangrijke onderwerpen uit de richtlijn, het praktisch toepassen van aanbevolen meetinstrumenten en het praktisch uitvoeren van relevante oefeningen. Voor dit doel werd de medewerking verkregen van drie patiënten met heup- of knieartrose, met wiens hulp de praktijkonderdelen geoefend konden worden. Discussies over alle onderwerpen en stappen in het onderzoek-, behandel- en evaluatieproces werden gevoerd volgens een proces van klinisch redeneren.
In hoofdstuk 4 wordt een studie beschreven waarin de interactieve workshop over de KNGF-richtlijn Artrose Heup en Knie wordt vergeleken met de conventionele presentatie over de richtlijn, beide aanvullend aan de passieve disseminatie strategie. Het effect werd gemeten aan de hand van de kennis over en het gebruik van de richtlijn 1 week na en 3 maanden na de nascholing. In deze studie werden fysiotherapeuten uit drie regio's in Nederland uitgenodigd en via randomisatie toegewezen aan één van de twee scholingsvormen (108 in interactieve workshop groep en 95 in conventionele lezing groep). Direct na de scholing was de tevredenheid over de inhoud in de interactieve workshopgroep significant hoger dan in de groep die een conventionele lezing volgde. Aanbevelingen in de richtlijn werden in de interactieve workshopgroep na 3 maanden beter gevolgd dan in de conventionele groep terwijl de kennistoename vergelijkbaar was tussen de twee groepen.
Geconcludeerd werd dat om de implementatie van de richtlijn te bevorderen de interactieve workshop de meest effectieve vorm van nascholing was, en te prefereren strategie was voor een bredere implementatie in de zes regio's in Nederland waar nog geen nascholing over de richtlijn was aangeboden.

In **hoofdstuk 5** wordt een onderzoek beschreven waarin de interactieve workshop als aanvulling op de passieve disseminatie op grotere schaal werd geimplementeerd. Om het effect van deze nascholing in vergelijking met geen nascholing vast te kunnen stellen, werden in de nascholing geinteresseerde fysiotherapeuten via randomisatie toegewezen aan een controlegroep (n=133) of wachtlijstgroep (n=151), die de workshop zes maanden later aangeboden kreeg. De conclusie uit dit onderzoek was dat een korte interactieve workshop over de herziene KNGF-richtlijn Artrose Heup en Knie zowel 1 week na als 3 maanden na de nascholing een klein tot middelgroot effect liet zien op zelf gerapporteerd gebruik van de richtlijn in de dagelijkse praktijk en op de kennis over de richtlijn. Tevens werden er in de groep die de interactieve nascholing volgde op de lange termijn ook minder belemmeringen ervaren om de richtlijn te gebruiken. Op de korte termijn werd echter juist een tegengesteld effect gezien.

De KNGF-richtlijn Artrose Heup en Knie bevat ook aanbevelingen over de behandeling van patiënten die een gewrichtsvervangende operatie ondergaan (zie hoofdstuk 2). **Hoofdstuk 6** beschrijft het gebruik en de kenmerken van fysiotherapeutische interventies na een totale heup- of knieoperatie. Hiertoe werd een digitale vragenlijst verstuurd naar 957 fysiotherapeuten in de regio Zuidwest-Nederland. De vragenlijst betrof de toepassing en inhoud van interventies die a) aanbevolen werden in de richtlijn, b) noch waren aanbevolen noch afgeraden, en c) nog niet als aanbeveling waren opgenomen in de richtlijn. Het bleek dat het overgrote deel van de 219 respondenten aangaf vaak na totale heup of knieoperaties spierversterkende en functionele oefentherapie te geven zoals in de richtlijn werd aanbevolen. Echter, er werd ook een groot aantal andere interventies uitgevoerd waarvoor geen aanbevelingen waren geformuleerd in de richtlijn, zoals andere vormen van oefentherapie (balansoefeningen, arobe training en looptraining), passieve oefentherapie, ijspakkingen en massage. Hoewel deze bevindingen in een grotere, landelijke studie bevestigd zouden moeten worden, lijkt het nodig om meer aanbevelingen betreffende fysiotherapeutische interventies na een totale heup- of knieoperatie op te nemen in de richtlijn. Dit zou kunnen bijdragen aan de kwaliteit van de fysiotherapeutische behandeling na een gewrichtsvervangende operatie van heup of knie.
Er is nog weinig onderzoek gedaan waarin aan patiënten zelf wordt gevraagd wat zij voor fysiotherapeutische behandeling hebben gekregen voor en na een totale heup- of knieoperatie. In **Hoofdstuk 7** wordt beschreven wat 521 heup- en knieartrosepatiënten uit vier verschillende ziekenhuizen zelf rapporteerden over de fysiotherapeutische behandeling die zij hadden ontvangen voor en/of na een gewrichtsvervangende operatie. Het onderzoek vond plaats in 2012, en richtte zich op pateinten die in 2011 (5-22 maanden geleden) waren geopereerd. De vragenlijst die zij invulden bestond uit vragen over verwijzing, locatie, duur en inhoud van de fysiotherapie voor en na de operatie. Bijna iedere patiënt (98%) kreeg fysiotherapie na de operatie en 40% van

hen maakte ook voor de operatie gebruik van fysiotherapie. Patiënten rapporteerden een aanzienlijke variatie aan ontvangen fysiotherapeutische interventies, met name vòòr de operatie. Het vragenlijstonderzoek werd in slechts vier ziekenhuizen in een specifieke regio in Nederland uitgevoerd. Daarom moeten we voorzichtig zijn met conclusies op basis van deze resultaten. Desondanks is de praktijkvariatie zodanig dat in de toekomst verder onderzoek noodzakelijk lijkt. Daarin kan onderzocht worden welke fysiotherapeutische interventies bij welke patienten wel en welke niet voor en na een totale heup- en totale knieoperatie gegeven zouden moeten worden. Dit zou meer richting kunnen geven aan de kwaliteit van de fysiotherapeutische zorg voor deze patiëntenpopulatie.
In Hoofdstuk 8 wordt verslag gedaan van een onderzoek naar het vóórkomen van comorbiditeit (nevenaandoeningen) bij heup- en knieartrose patiënten die ruim een jaar eerder een gewrichtsvervangende operatie hadden ondergaan. Hiertoe werd een bestaande vragenlijst van het Centraal Bureau voor Statistiek (CBS), bestaande uit 19 verschillende vormen van comorbiditeit, gebruikt. Er werd onderzocht in hoeverre deze aandoeningen aanwezig waren en ook in hoeverre zij gerelateerd waren aan verschillende uitkomsten na een totale heup- of totale knieoperatie. De meest vòòrkomend gerapporteerde vormen van comorbiditeit waren (>15%) waren: ernstige rugpijn; nek/schouderpijn; elleboog, pols of handpijn; hoge bloeddruk; urine incontinentie; gehoorproblemen; zichtbeperkingen; en kanker. Een hoger aantal vormen van comorbiditeit was meer geassocieerd met uitkomst bij een mensen met een totale heup dan een totale knie. En in analyses bij comorbiditeit die in meer dan 5% voorkwam waren duizelighied in combinatie met vallen en ernstige rugpijn bij totale heup en toitale knie, en duizeligheid, zichtbeperkingen bij lange afstand en elleboog, pols of handpijn het meest geassocieerd met uitkomst.
Concluderend op basis van deze studie lijkt het zinvol dat rekening gehouden wordt met een breed scala aan vormen van comorbiditeit om een preciezere voorspelling te kunnen doen over het functionele resultaat na een totale heup- of totale knieoperatie. Met name de aanwezigheid van duizeligheid in combinatie met vallen bij mensen met heup- en knieartrose, ernstige lage rugpijn bij heupartrose en zichtbeperkingen en elleboog, pols of handpijn bij knieartrose zouden onderzocht en indien mogelijk behandeld kunnen worden. Hierdoor zou de kans op een teleurstellende uitkomst na een gewrichtsvervangende operatie van de heup of knie mogelijk verminderd kunnen worden. Daarnaast lijkt ook de toename van het aantal vormen van comorbiditeit dat aanwezig is bij één persoon, in toenemende mate een slechte uitkomst te beïnvloeden. Verder onderzoek naar het beloop van de functionele uitkomst in de tijd is nodig om deze bevindingen te kunnen bevestigen.
Tot slot worden in **Hoofdstuk 9** de studies in dit proefschrift bediscussieerd. Fysiotherapie is één van de basiselementen in de behandeling van patiënten met artrose van het heup- of kniegewricht, ook als zij een gewrichtsvervangende operatie ondergaan.

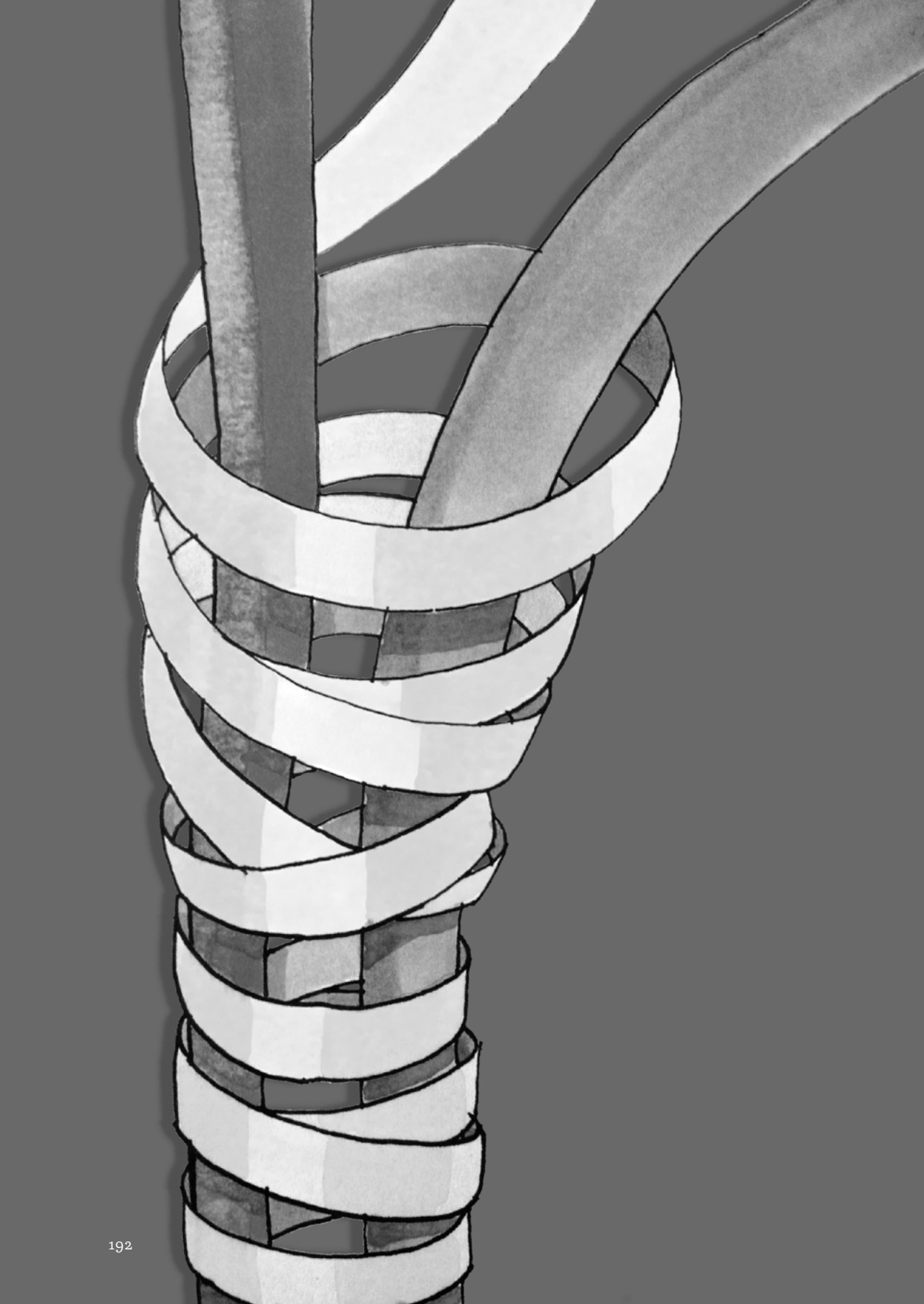
Deze zorg wordt beschreven in richtlijnen in het algemeen en in meer detail in de KNGF-richtlijn zoals beschreven in dit proefschrift. Hoewel de richtlijn op een gestandaardiseerde manier ontwikkeld is volgens internationale richtlijnen, kan de ontwikkeling van de richtlijn verbeterd worden door in de toekomst vanaf het eerste begin praktiserend fysiotherapeuten, patiënten en zorgverleners van andere disciplines er nauwer bij te betrekken. Verder dient bij de ontwikkeling van elke richtlijn een actieve implementatiestrategie toegevoegd te worden, zodat de kans dat de richtlijn daadwerkelijk toegepast wordt in de dagelijkse praktijk, vergroot wordt.

Het verdient daarnaast aanbeveling om een set van kwaliteitsindicatoren in de richtlijn zelf op te nemen. Behalve dat hiermee op het niveau van patienten uitspraken kunnen worden gedaan over de kwaliteit van zorg voor mensen met heup en knieartrose is het belangrijk dat deze set geschikt is als instrument waarmee fysiotherapeuten zelf de kwaliteit van zorg in hun eigen praktijk beoordelen en waar nodig verbeteren. De set van kwaliteitsindicatoren zoals beschreven in dit proefschrift vormt slechts een eerste aanzet en kan verder verbeterd worden met behulp van recent ontwikkelde en nu ook beschikbare methodiek, het Appraisal of Guidelines for Research & Evaluation (AGREE) II QI (Quality Indicator) instrument. Hierin worden de eisen beschreven waaraan kwaliteitsindicatoren zou moeten voldoen. Verder is het belangrijk om te onderzoeken hoe die indicatoren het best geformuleerd kunnen worden zodat zij gemakkelijk en betrouwbaar gemeten kunnen worden.

Interactieve scholing voor professionals is een bewezen effectieve implementatiestrategie om richtlijngebruik te bevorderen. Maar dit is slechts accenten één manier waarop de implementatie van een richtlijn bevorderd kan worden. Ook op het niveau van bijvoorbeeld de patiënt- of organisatienvieau kunnen implementatiestrategieën toegepast worden. Een voorbeeld van op de patient gerichte implementatiestrategie zijn de, via het Eumscnet ontwikkelde standards of care (http://eumusc.net/workpackages_wp6.cfm) waarmee patienten met heup of knieartrose zelf gemakkelijk kunnen checken of zij passende zorg ontvangen.

In de KNGF-richtlijn wordt een beperkt aantal aanbevelingen voor fysiotherapie na een heup- of knievervangende operatie beschreven. Zowel de literatuur als de studie naar de dagelijkse praktijk in dit proefschrift laten zien dat er naast de toepassing van aanbevolen interventies een grote variëteit aan andere interventies wordt toegepast voor en na de operatie. Dit wordt door zowel fysiotherapeuten als patiënten aangegeven. Gezien het toenemende aantal gewrichtsvervangende operaties en de belangrijke rol van fysiotherapie in het revalidatieproces lijkt het noodzakelijk om meer en duidelijkere aanbevelingen over perioperatieve fysiotherapie te ontwikkelen. Het KNGF heeft inmiddels het initiatief genomen om om een specifieke fysiotherapie richtlijn voor totale heup- en kniearthropalsitek te ontwikkelen. Gezien de verschillen die er bestaan tussen heup- en knieartrose ten aanzien van klachtenpatroon, benadering en beloop, lijkt het zinvol om deze twee aandoeningen apart te bekijken.

Tenslotte wordt een bevredigende uitkomst van een gewrichtsvervangende operatie niet alleen bepaald door een technisch kwaliteit van de operatie en adequate revalidatie. Ook de aanwezigheid van comorbiditeit kan invloed hebben op het resultaat van een operatie. Daarmee dient dus rekening gehouden te worden voorafgaand aan een gewrichtsvervangende operatie van de heup of knie. In dit proefschrift is een verband vastgesteld tussen diverse vormen van comorbiditeit aanwezig na de operatie en de uitkomsten van de operatie. Om een valide uitspraak te kunnen doen over de rol van comorbiditeit bij totale heup- en kniechrirugie zou toekomstig onderzoek prospectief van opzet moeten zijn, met gedetailleerde metingen van de aanwezigheid van comorbiditeit voor en na de operatie. Hiertoe moeten andere instrumenten om mogelijke specifieke vormen comorbditeit te inventariseren worden ingezet, dan de op dit moment gangbare Charnley Classificatie, die uitsluitend vraagt naar de invloed van andere aangedane gewrichten, medische en psychische aandoeningen. Zo kan er inzicht worden verkregen in de voorspellende waarde van diverse aanwezige vormen van comorbiditeit en combinaties daarvan op postoperatieve resultaten. Vooral de invloed van sensorische comorbiditeit als duizeligheid en visusproblemen waar nog niet veel onderzoek naar is gedaan, dient dan meegenomen te worden. Voor de klinische praktijk kan dit betekenen dat om het resultaat van heup en knie operaties bij bepaalde subgroepen te verbeteren wellicht behandeling van comorbditeit voorafgaand aan de operatie of in het revalidatietraject moeten worden ingezet.



Appendix

List of publications

Curriculum Vitae

Dankwoord

List of Publications

Peter WF, Loos M, de Vet HCW, Boers M, Harlaar J, Roorda LD, Poolman RW, Scholtes VAB, Boogaard J, Buitelaar H, Steultjens M, Roos EM, Guillemin F, Rat AC, Benedetti MG, Escobar A, Østerås N, Terwee CB. Development and preliminary testing of a computerized Animated Activity Questionnaire (AAQ) in patients with hip and knee osteoarthritis. Arthritis Care Res (Hoboken). 2014 Jun 25. doi: 10.1002/acr.22386. [Epub ahead of print].

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Curriculum Vitae

Wilfred Peter werd op 3 april 1965 geboren in Zaandam. Na het behalen van het Atheneum diploma op het St. Michaël College in Zaandam, begon hij in 1984 met de opleiding fysiotherapie aan de Stichting Academie Fysiotherapie Amsterdam (SAFA), die hij in 1988 afrondde. Na waarnemingen als fysiotherapeut in diverse settings binnen de gezondheidszorg begon hij in 1991 te werken op de afdeling fysiotherapie in het Jan van Breemen Instituut te Amsterdam. In dit revalidatiecentrum, tegenwoordig Reade, centrum voor revalidatie en reumatologie geheten, is hij nog steeds als fysiotherapeut werkzaam. In 2011 heeft hij ReumaNetAmsterdam opgezet, een reumanetwerk voor *health professionals* en patiënten in de regio Amsterdam. Sinds 2012 is hij voorzitter van de landelijke sectie fysiotherapie van de Nederlands Health Professionals in de Reumatologie (NHPR), onderdeel van de Nederlandse Vereniging voor Reumatologie (NVR).
In 2008 begon hij zijn promotietraject in het Leids Universitair Medisch Centrum, eerst op de afdeling Reumatologie, later op de afdeling Orthopaedie, waar hij het in 2014 heeft afgerond. Sinds 2012 is hij werkzaam bij het EMGO Instituut op de afdeling Epidemiologie en Biostatistiek van de Vrije Universiteit te Amsterdam. Als uitvoerend onderzoeker is hij betrokken bij een internationaal onderzoeksproject waarbij een computergestuurde animatie vragenlijst ontwikkeld wordt om beperkingen in activiteiten te meten bij mensen met artrose aan de heup of knie.

Dankwoord

Nu het eindelijk gelukt is om dit proefschrift tot een goed einde te brengen rest mij een dankwoord voor iedereen die een bijdrage heeft geleverd aan de totstandkoming ervan.
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Mijn directe collega's in Reade (in het begin nog het Jan van Breemen Instituut) wil ik bedanken, omdat ik dankzij de prettige en gezellige werksfeer op de afdeling het onderzoekswerk goed heb kunnen combineren met de patiëntenzorg. In het bijzonder wil ik Lida, en later Inge, bedanken voor de ruimte die ik heb gekregen om deze combinatie ook mogelijk te maken. Inge, ontzettend bedankt dat je mijn ontwikkeling van de laatste jaren hebt willen faciliteren.
Mijn eerste stappen in het onderzoek zijn begonnen in het toenmalige Jan van Breemen Instituut en twee mensen hebben daar een belangrijke rol in gespeeld. Martin, bedankt voor al je werk en energie voor het ontwikkelen van een mooie paramedische

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