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## Chapter 9

# Summary and General Discussion

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## Summary

Osteoarthritis (OA) of the hip or knee is one of the most prevalent joint disorders, causing pain and disability<sup>1</sup>, and constituting a significant socio-economic burden for society.<sup>2</sup> Physiotherapy (PT) is one of the cornerstones of the conservative management of patients with hip and knee OA.<sup>3</sup> 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.<sup>4-6</sup>

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; post-operative 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.<sup>7,8</sup> 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.<sup>9-13</sup> Thus, the use of active implementation strategies, in addition to passive dissemination, has been recommended.<sup>9-12</sup> 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 post-operative 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.<sup>14,15</sup> 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 TKA<sup>16</sup>, 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  $\geq 1$  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.<sup>17</sup> 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.<sup>18</sup> 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)<sup>19</sup>, a guideline on the total hip replacement<sup>20</sup> and a draft guideline regarding total knee replacement of the Dutch Orthopaedic Association (Nederlandse Orthopaedische Vereniging; NOV)<sup>21</sup>.

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.<sup>22</sup> 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.<sup>23</sup> 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<sup>19</sup> and the guideline on the total hip replacement of the NOV<sup>20</sup>, no details regarding rehabilitation were described. Only a draft guideline regarding total knee replacement of the NOV<sup>21</sup> 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.<sup>24</sup>

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<sup>25,26</sup>, were not developed according to international guidelines for QIs<sup>17</sup>, or were based on an older version of a guideline.<sup>27</sup> 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<sup>28</sup>, and used in some studies<sup>29,30</sup>, 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.<sup>31-34</sup> 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.<sup>35</sup> 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](http://eumusc.net/workpackages_wp6.cfm)).<sup>36</sup>

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.<sup>25</sup>

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.<sup>8-11</sup> 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.<sup>37,38</sup> 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.<sup>39,40</sup> 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](http://www.zorgvoorbeweging.nl)) as well as at the internet ([www.orthopedend.org](http://www.orthopedend.org) ; and [www.mijnbesteheup.nl](http://www.mijnbesteheup.nl) ). Other examples targeted at patients include the care booklet hip and knee osteoarthritis (Zorgwijzer Heup en Knieartrose)<sup>41</sup>, developed in the context of the BART (Beating osteoarthritis) project.<sup>42,43</sup>

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<sup>44</sup>, 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<sup>44</sup>, 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<sup>45</sup> 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<sup>24</sup> 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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