Determinants of outcome prior to and after total hip and knee arthroplasty

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Chapter X.

General Discussion

This thesis focused on patient-reported pain, function and participation in patients with hip or knee OA prior to and after total hip or knee arthroplasty (THA and TKA). Based on the ICF-model, a comprehensive model for health status, specifically the ICF core set for OA (1-3), three study aims were formulated in the introduction:

1. To investigate associations between radiographic OA severity, knee instability, pain and function prior to and after THA and/or TKA
2. To evaluate factors influencing physical activities in patients with end-stage hip or knee OA.
3. To identify determinants of return to work after THA or TKA.

The current chapter discusses the results and clinical implications of the abovementioned aims consecutively.

Part 1. Associations between radiographic OA severity, knee instability, pain and function prior to and after THA and/or TKA.

Effect modification of radiographic OA severity on the effect of preoperative pain on postoperative pain and function (Chapter 2)

The results of the study described in Chapter 2 showed that, in line with the literature, less radiographic OA severity and more preoperative pain were associated with worse postoperative pain (Chapter 2) (4-8). Function was solely affected by radiographic OA severity (4, 5). To our knowledge, no previous study investigated the combined effect of OA severity and preoperative pain on postoperative outcomes. We found that the effect of preoperative pain on the postoperative outcomes seemed to become less important when patients had more severe OA. We believe that this effect modification of radiographic OA severity on the association of preoperative pain with postoperative outcomes should be taken into account, when new prognostic models for outcomes after TKA are developed. Another interesting finding was that a substantial part of the included patients (12%) had only mild radiographic OA according to the KL score. In these patients, pain or functional disability were probably the main indications for surgery rather than their OA severity. Accordingly, the finding may also indicate that, in these patients, structural damage of the knee may not have been the major driver of perceived pain. It may indeed be more plausible that other mechanisms, such as central pain

sensitization, may underlie pain levels (7). When pain sensitization is apparent, the central nervous system is altered in such a way that patients experience more pain than one should expect with a certain provocation (7). A previous study showed that increased central pain sensitization was apparent in OA patients who perceived much pain but who had little radiographic OA severity (7). Consequently, if the main source of the pain is not structural damage of the knee, patients with low radiographic OA severity and much perceived pain will gain less improvement from TKA compared to patients with high radiographic OA severity who experience the same levels of pain. More research on the source of pain in knee OA patients with mild structural damage of the knee joint is necessary.

Recovery trajectories after total hip and knee arthroplasty and early postoperative identification of patients at risk for unfavourable one-year outcome (Chapter 3)

In this thesis we showed that patients at risk for an unfavourable pain or function outcome at one-year could be identified six months postoperatively by preoperative pain and function scores as well as clinical change in the first six months (Chapter 3). Early postoperative identification of patients at risk for one-year unfavourable outcomes provides the opportunity to start early interventions for optimising clinical outcome (9, 10). These early postoperative interventions could probably result in shortened time to recovery, reduced distress to patients and maximized cost-effectiveness for the healthcare system as such (11). Besides, early postoperative identification of patients at risk for unfavourable long-term outcome, could help orthopaedic surgeons to identify which patients should be invited for follow-up visits at the outpatient clinic. Currently, many orthopaedic surgeons invite all patients for routine follow-up visits during the first postoperative year. This imposes substantial costs to the health care system, whereas in only very few cases patient management is altered (12, 13). Although the latter is true from a managerial perspective, the patient perspective on subjective well-being and reassurance on outcome has to be taken into account as well in future studies. Further research should identify the generalizability of our findings in other cohorts and focus on rehabilitation strategies improving outcomes in patients with unfavourable initial recovery.

Knee instability and its associations with radiographic features, pain, function and QoL (Chapters 4 and 5)

The majority of patients (72%) with knee OA reported knee instability prior to TKA. Although we hypothesised that self-reported knee instability would be associated with radiographic features, no associations were found. This suggests that structural damage of the knee prior to TKA might not be related to the sense of knee instability, whereas previous studies suggested that either osteophyte formation prevented the progression of instability or joint space narrowing contributed to a higher prevalence of instability in OA knees (14-16). Possible explanations for the discrepancy could be related to the definition of stability (varus-valgus laxity versus self-reported knee stability) and the different types of osteophytes (17, 18). A recent radiographic study on the size and direction of osteophytes in knee OA suggested that only small, predominantly outward extending osteophytes (i.e. increasing the surface area of the joint) create stability (18). Thus, future studies should not only include size, but also the location of osteophytes when analysing the association with instability.

In another analysis it was found that one year following TKA, the proportion of patients with perceived instability was much lower than before surgery, with 21% of the patients reporting a sense of knee instability. Of the patients with preoperative knee instability, this perception was retained in 25%. Pre-, postoperative and retained knee instability were associated with more perceived pain, activity limitations, and poorer QoL. Potential underlying mechanisms for these associations include muscle weakness and fear of movement, closely related to pain catastrophizing (19-22). Muscle weakness, a factor associated with complaints of OA, may contribute to a delayed response of muscles to sudden forces on the knee, which results in excessive moments of the knee joint and the perception of knee joint instability (19). This suggests that improving muscle strength could be a target for intervention. Furthermore, the associations between knee instability and perceived pain, activity limitations and (to a lesser extent) QoL could be related to the previous found association between knee stability and fear of movement (23, 24). Fear of movement results, according to the fear-avoidance model, in decreased physical activity, which worsens pain perception, increases

pain catastrophizing and alters joint proprioception. Proprioception is one of the main factors affecting the sense of joint instability (23). Fear of movement could thereby increase the sense of joint instability, which leads to more avoidance of activities and increased pain catastrophising (23, 24). Future studies should identify if improving fear-avoidance and encouraging performance can improve proprioception and thus the sense of knee instability. From a clinical perspective, knee instability might help orthopaedic surgeons to evaluate outcome after TKA. Due to the associations with clinical outcomes, retained knee joint instability could be an easily identifiable alarm symptom for poor clinical outcomes. When retained knee joint instability is present, orthopaedic surgeons should be aware of a higher risk for poor clinical outcomes.

Part 2. Factors influencing physical activity in patients with end-stage hip or knee OA

In Chapter 6 we showed that joint pain and functional limitations were not associated with physical activity as measured with an accelerometer in neither hip nor knee OA patients scheduled for joint replacement. However, in hip OA patients QoL was associated with objectively measured physical activity. The observation that pain and functional limitations do not influence objective physical activity levels are in line with previous studies, that concluded that patients with OA are equally active as compared to the general population (25) and that physical activity levels do not increase after interventions such as THA or TKA (26, 27). If OA-related complaints are not associated with objectively measured physical activity, no difference is to be expected in physical activity levels between OA patients compared to the general population, or after interventions for hip or knee OA such as THA or TKA. There are several potential explanations for the absence of an association between pain or functional limitations with objectively measured physical activity. First, physical activity may be more related to a general lifestyle and overall health than to specific health problems, which is supported by previous studies as well as emphasized by our own result regarding QoL (28, 29). Second, patients could have retained activities despite symptoms, because some activities simply have to be performed (like washing oneself, cleaning or cooking) (30). Third, as recommended by international guidelines,

patients with severe pain and functional disability could have retained their physical activity levels in order to reduce their symptoms or improve their overall health to be optimal prepared for a surgical treatment (30-33). Our research showed that incorporation of an accelerometer-study within the logistics of a large, multicentre cohort study, such as the LOAS, involved substantial efforts and difficulties. Especially the collection and processing of accelerometer-data was time-consuming and several technical problems occurred, such as software errors or loss of data due to damaged or lost devices. It is expected that research with wearable technology such as accelerometers may become more feasible in the future when personal devices such as watches and personal phones become more widely available and accessible for research purposes (34). Our conclusions are important to address in the preoperative consultation when outcome expectations are discussed.

Part 3. Determinants for return to work after THA or TKA

Chapter 7 focused on identification of determinants of return to work in both THA and TKA patients 12 months postoperative as well as differences between these two patient groups. In THA patients, self-employment, preoperative absence from work and less preoperative functional limitations were associated with partial or no return to work one year after surgery. Yet, in patients undergoing TKA only preoperative absence from work was associated with partial or no return to work. Besides, type of surgery (hip or knee) modified the effect of preoperative functional limitations on return to work. Thus, in patients undergoing THA, less preoperative functional limitations were associated with partial or no return to work, whereas in patients undergoing TKA a trend was seen of worse preoperative functional limitations being associated with no or partial return to work. The latter is in accordance with previous literature, whereas the first is more difficult to explain (35). However the improvement in functional limitations was better in patients who returned partially or not as compared to patients who fully returned to work. This resulted in similar postoperative scores regarding functional limitations, questioning the clinical relevance of the preoperative difference. Besides, we showed that a substantial number of patients returned to work, yet with reduced working hours. Future research should identify to what

extent the reduction in working hours was related to the THA or TKA, or can be explained by other factors such as planned partial retirement or worsening of the economic tide. These results suggest that strategies aiming to influence modifiable factors need to consider THA and TKA separately.

In addition, in Chapter 8 we hypothesized that preoperative physical activity was associated with return to work after TKA. However, no association between preoperative physical activity and full return to work after TKA was found. Instead, patient beliefs and preoperative expectations (self-reported work-relatedness of knee symptoms and the expected timing of return to work) did influence return to work. A potential explanation for the absence of an association between physical activity and return to work, is that we measured self-reported physical activity. It is likely that this resulted in an overestimation of the actual physical activity, particularly in patients that are not physically active (36). Another explanation might be that we combined patients that partially returned to work and patients that did not return to work (37). It is still possible that physical activity differs between partial and no return to work. In addition, we found that certain beliefs and expectations regarding return to work influenced the actual return to work. The latter confirms that patient beliefs about the work-related cause of their knee complaints and preoperative expectations regarding timely return to work play an important role in the overall process of patients before they return to full-time work after TKA (38). This is in line with previous studies regarding overall expectations after TKA. Preoperative expectations towards TKA outcome were consistently associated with the actual postoperative outcome (39). Therefore, when planning surgical treatment, orthopaedic surgeons should take patients' expectations towards surgery and return to work into account. With respect to return to work, providing adequate and sufficient preoperative information regarding return to work and/or referring to an occupational physician for an evaluation of the work-relatedness of knee symptoms and for timely work-directed care may improve return to work of these patients (40).
Overall, this thesis contributed to knowledge on preoperative factors associated with outcome after total joint arthroplasty of the lower

extremity. The research from this thesis yielded several findings related to various levels of outcomes: (1) the combination of preoperative radiographic OA severity and pain appeared to be important for the expected postoperative pain/function outcome, as preoperative radiographic OA severity was found to modify the effect of preoperative pain on postoperative pain/function; (2) PROs, specifically those reflecting the initial clinical recovery and preoperative scores of pain and function, could be used for the early postoperative identification of patients at risk for unfavorable outcome at six months postoperatively. PROs that are administered relatively early after surgery may help orthopaedic surgeons to identify which patients should be eligible for an enhanced rehabilitation strategy, potentially reducing the risk on poor outcome; (3) knee-instability could be considered as an easy identifiable surrogate outcome for more pain, and worse function and QoL; and (4) gathering information on patients' work status preoperatively (specifically absence from work) and expectations about return to work and the rehabilitation trajectory could be important to improve the speed of return to work after THA or TKA. More research in these areas is needed to identify the consistency of the results and to eventually adjust clinical decision making preoperatively as well as postoperatively. Moreover, future studies should identify which early postoperative interventions for patients at risk for unfavourable outcomes would be (cost)effective as well as the optimal timing for early postoperative screening.

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