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

Leichtenberg, C.S.

Chapter IX

Summary

Aims of this thesis

Osteoarthritis (OA) is among one of the most common causes of disability in older adults worldwide, with the most prevalent forms being knee, hip, hand and cervical spine OA (1, 2). Total hip and knee arthroplasties (THA and TKA) are, according to clinical outcomes (pain relief and functional improvement) and survival analyses of implants, very effective interventions for patients with hip or knee OA (3-6). Apart from the technical result, the patient's perception of outcome is extremely relevant (7-13). Since the last decades, a holistic approach and the perspective of the patient has become more and more important in health care in general, in particular in outcomes research. The International Classification of Functioning, Disability and Health (ICF) is a comprehensive framework to describe health status, as well as external and personal factors that may have an impact on a person's health (14). In accordance with the ICF, disease specific core sets, including the aspects of health most relevant for patients with a specific condition and their physicians were developed, including an ICF core set for OA (15). The current thesis focuses on a subset of aspects described in the ICF core set for OA that are currently insufficiently researched.

In THA and TKA patients, knowledge of certain components of the ICF domains, specifically knee instability, physical activity and return to work and their association with pain and function prior to and after THA and TKA is limited. Therefore, the aims of this thesis were:

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 studies described in Chapters 2-6 and 8 were based on the multicentre Longitudinal Leiden Orthopeadics Outcomes of Osteo-Arthritis study (LOAS), a multi-center, longitudinal prospective cohort study. The analyses in this thesis were done with the data from patients enrolled before June 2015. The study described in Chapter 7 was based

on data from a one-year observational cohort study including consecutive patients undergoing primary THA or TKA for osteoarthritis in the Alrijne Hospital, Leiderdorp, the Netherlands, between October 2010 and September 2012.

Part 1. Preoperative (and early postoperative) pain and function, radiographic OA severity and knee instability and their association with postoperative pain and function outcome.

Effect modification of radiographic OA severity on the effect of preoperative pain on postoperative pain and function

The study described in Chapter 2 investigated whether preoperative radiographic OA severity modified the effect of preoperative self-reported pain on postoperative pain and function 1 and 2 years after TKA. Data were derived from the multicentre observational LOAS study. OA severity was assessed radiographically with the Kellgren and Lawrence (KL) score. Pain and function were evaluated with subscales of the Knee Injury and Osteoarthritis Outcome Score (KOOS). After adjustment for Body Mass Index (BMI), age, sex, and the Mental Health Component scores from the Short Form-12, multivariate linear regression analyses with an interaction term between the preoperative KL score and preoperative pain were performed.

This analysis included 559 TKA patients. The results showed that a worse preoperative radiological OA severity score was associated with higher one- and two-year postoperative pain and worse one- and two-year postoperative function, while more preoperative pain only associated with more postoperative pain, not with a worse postoperative function. Moreover, a trend was found toward the preoperative OA severity score modifying the effect of preoperative pain on one-year postoperative pain (β −0.1; 95% Confidence Interval (CI) −0.1-0.0) and two-year postoperative pain (β −0.1; 95% CI −0.2-0.0), with the effect of preoperative pain on postoperative pain seeming to become less important when the preoperative OA severity score worsened. Similar results were found for the effect modification of preoperative OA severity on the association between preoperative pain and one- and two-year

postoperative function (β –0.1; 95% CI –0.2-0.0 for both). In conclusion, patients with less pain and worse OA severity preoperatively had better pain and function outcomes one and two years after TKA. However, the effect of preoperative pain on the postoperative outcomes seems to become less important when there was more severe radiographic evidence of OA. These results suggest that it is recommended to consider this effect modification of radiographic OA severity and preoperative pain on postoperative outcomes when new prognostic models for outcomes after TKA are developed.

Recovery trajectories after THA and TKA and early postoperative identification of patients at risk for unfavourable one-year outcome

The study presented in Chapter 3 evaluated the initial clinical recovery after primary THA or TKA up and until one year. In order to do so, four clinically relevant recovery trajectories of pain and function were used. Moreover, it was investigated if one-year pain/function could be predicted by the initial clinical recovery of pain/function and their preoperative values. Self-reported pain and function were assessed preoperatively, six and 12 months after surgery with the Pain and Activity Daily Living (ADL) subscales of the Hip Injury and Osteoarthritis Outcome Score (HOOS) and KOOS. Cut-off for unfavourable pain and function were based on the 20th percentile of its one-year outcomes. The six months assessments were taken to evaluate the initial clinical recovery. Prediction of one-year outcome by the initial clinical recovery of pain/function and their preoperative values was assessed with multivariate logistic regression analyses and Receiver Operating Curves.

This analyses included 972 THA and 892 TKP patients. Most patients, 70% of both THA and TKA patients, had a favourable outcome at 6 months and one-year. Ten percent THA and 12% TKA patients had an initial unfavourable outcome at 6 months, whereas 14% of THA/TKA patients had initial and one-year unfavourable pain outcomes. Similar results were found for function. Hence, of the patients with initial unfavourable outcome, 33-46% attained favourable one-year outcome. For both THA and TKA, more initial clinical recovery and worse preoperative pain/function predicted unfavourable one-year outcomes

(all ORs 0.96-0.97), whereas a prediction model including both variables attained the best prediction (AUCs of full models were approximately 0.89). Thus, patients with more preoperative pain/worse preoperative function and little initial clinical improvement had an increased risk of more pain or worse function one-year after surgery. In conclusion, of the patients with initial unfavourable outcome, approximately one-third attained favourable outcome at one-year. Patients at risk for one-year unfavourable outcome could be identified six months postoperatively by initial clinical recovery and preoperative values. These results may help orthopaedic surgeons to identify which patients should be invited at the outpatient clinic for an altered rehabilitation strategy, potentially reducing the risk on poor outcome.

Knee instability and its associations with radiographic features, pain, function and QoL

Chapter 4 described the prevalence of self-reported knee instability in patients with pre-surgery knee OA and explored associations between self-reported knee instability and radiological features. Radiological features consisted of joint space narrowing (JSN) and osteophyte formation on a 0-3 scale. Scores >1 were defined as substantial JSN or osteophyte formation. Logistic regression analyses were provided to identify associations of radiological features with self-reported knee instability.

This analysis included 265 patients with knee OA. Knee instability was reported by the majority (72%) of patients. Self-reported knee instability was not associated with JSN or osteophyte formation (relative to score 0, odds ratios of score 1-3 ranged 0.68-0.98 and 0.69-0.89, respectively). A stratified analysis for pain, age and BMI showed no associations between self-reported knee joint instability and radiological OA features. From these results it was concluded that self-reported knee instability was not associated with JSN or osteophyte formation.

In Chapter 5 the course and prevalence of self-reported knee instability before and one year after TKA was evaluated. Furthermore, the associations of preoperative, postoperative, and retained self-reported knee instability with pain, activity limitations, and QoL in patients with knee OA were explored. Pain, activity limitations, and QoL were evaluated

with the KOOS subscales. Multivariable linear regression analyses were performed adjusted for covariates (age, gender, comorbidities, and radiographic severity).
In this study data of 908 patients with an indication for TKA were included. Following TKA, knee instability was reported by 21% of all included patients and 25% of the 649 patients who reported preoperative knee instability. In line with previous studies, associations were found between preoperative knee instability and preoperative pain, activity limitations, and QoL. Moreover, our results showed that associations were even stronger between postoperative and retained knee instability with postoperative pain, activity limitations, and QoL. In conclusion, in clinical care, self-reported knee instability is retained postoperatively in about 25% of TKA patients. Retained knee instability is associated with more postoperative pain, activity limitations, and poorer QoL. As such, perceived retained knee instability could be an easily identifiable alarm symptom for poor clinical outcome after TKA, which could be used by orthopaedic surgeons.

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

In Chapter 6 it was investigated if OA-associated pain, functional limitations and QoL were associated with objective measurements of physical activity in patients with end-stage hip/knee OA. Included patients wore an accelerometer (Activ8) for 5-7 days with physical activity expressed as number of activity daily counts (ADC) per hour, percentage time spent on physical activity and percentage time spent sedentary. The HOOS/KOOS and Short Form (SF)-12 were used to assess pain, functional limitations and joint-specific and general QoL. Multivariate linear regression models with the three to Z-scores transformed parameters of physical activity as dependent variables and adjusted for confounding, were used for analysis.

This analysis included 49 hip OA and 48 knee OA patients. The results showed that in hip OA patients, better joint-specific and general QoL were associated with more ADC, (β 0.028 (95% CI 0.007–0.048), β 0.041 (95% CI 0.010–0.071), respectively). Also, better general QoL was

associated with a higher percentage time spent on physical activity (β 0.040 (95%CI 0.007–0.073)). No other associations were found for either hip or knee OA patients. To conclude, whereas QoL was associated with objective measurements of physical activity in hip OA, pain and functional limitations were not related to objective measurements of physical activity in patients with end-stage hip or knee OA. 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

The studies in Chapters 7 and 8 aimed to identify determinants of return to work after THA or TKA. In Chapter 7 determinants of return to work were compared after THA and TKA. Patients with a paid job and aged <65 years were included. The outcome measure was the presence of full versus partial (working less hours) or no return to work 12 months postoperatively. Potential determinants were preoperative sociodemographic and work characteristics and joint function.

In this analysis 67 THA and 56 TKA patients were included. Of the included THA patients, 13% returned as part-time workers and 7% did not return to work one year postoperative. For TKA patients these numbers were 19% and 11%, respectively. In THA patients, preoperative factors associated with partial or no return to work were: self-employment, absence from work and a better function score. Whereas in TKA patients only absence from work was associated with partial or no return to work. Type of surgery (THA/TKA) modified the effect of the function score on return to work. In conclusion, both in THA and TKA patients, preoperative absence from work was associated with return to work, whereas only in THA patients self-employment and better preoperative function were. Moreover, the impact of preoperative function on return to work was modified by type of surgery. These results suggest that strategies aiming to influence potentially modifiable factors in the postoperative course of THA and TKA need to evaluate THA and TKA separately.

In Chapter 8 we hypothesized that preoperative physical activity (PA) would be associated with return to work after TKA. Work status and

PA level according to the Dutch Recommendation for health-enhancing PA (NNGB) and the Fitnorm were assessed preoperative and 1 year postoperative. A multivariate logistic regression analysis was used to evaluate the effect of PA on return to work, adjusting for prognostic factors for return to work among TKA patients.

The analysis included 266 working patients undergoing TKA, with a mean age of 58 years old. Preoperative, 54% of patients performed moderate PA for ≥5 days/week and 16% performed intense PA for ≥3 days/week. Concerning return to work, 67% of patients reported full return to work, 22% partial return to work and 11% no return to work. Preoperative PA was not associated with return to work. Patients who reported that their knee symptoms were not or only partially work-related had lower odds for not returning to work (OR 0.37, 95% CI 0.17 – 0.81). Also, for each additional week patients expected to be absent from work, the likelihood of not returning to work increased (OR 1.11, 95% CI 1.03 – 1.18). In conclusion, no association between preoperative PA and return to work after TKA was found. Instead, patient beliefs and preoperative expectations did influence return to work and should be addressed to further improve return to work after TKA.

In conclusion, the research in this thesis showed that the combination of preoperative radiographic OA severity and pain perception of the patient are important predictors for the expected postoperative pain/function outcome due to effect modification. Furthermore, the initial clinical recovery after arthroplasty surgery and preoperative scores can be used during the postoperative recovery period to identify patients at risk for an unfavourable one-year outcome. Besides, it showed that knee-instability could be considered as an easy identifiable surrogate outcome for poor pain relief and poor function. Furthermore, pain and functional limitations were not associated with an objective technical measurement of physical activity in patients with end-stage hip or knee OA. Finally, we found that preoperative occupational information (more specifically preoperative absence from work) and work-related expectations are important predictors for return to work after THA or TKA.

References

1. Lawrence RC, Felson DT, Helmick CG, Arnold LM, Choi H, Deyo RA, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. Arthritis Rheum. 2008;58(1):26-35.
2. Laupattarakasem W, Laopaiboon M, Laupattarakasem P, Sumananont C. Arthroscopic debridement for knee osteoarthritis. Cochrane Database Syst Rev. 2008(1):CD005118.
3. Price AJ, Alvand A, Troelsen A, Katz JN, Hooper G, Gray A, et al. Knee replacement. Lancet (London, England). 2018;392(10158):1672-82.
4. Learmonth ID, Young C, Rorabeck C. The operation of the century: total hip replacement. Lancet (London, England). 2007;370(9597):1508-19.
5. Ferguson RJ, Palmer AJ, Taylor A, Porter ML, Malchau H, Glyn-Jones S. Hip replacement. Lancet (London, England). 2018;392(10158):1662-71.
6. Keurentjes JC, Pijls BG, Van Tol FR, Mentink JF, Mes SD, Schoones JW, et al. Which implant should we use for primary total hip replacement? A systematic review and meta-analysis. The Journal of bone and joint surgery American volume. 2014;96 Suppl 1:79-97.
7. Beswick AD, Wylde V, Gooberman-Hill R, Blom A, Dieppe P. What proportion of patients report long-term pain after total hip or knee replacement for osteoarthritis? A systematic review of prospective studies in unselected patients. BMJ Open. 2012;2(1):e000435.
8. Wright RJ, Sledge CB, Poss R, Ewald FC, Walsh ME, Lingard EA. Patient-reported outcome and survivorship after Kinemax total knee arthroplasty. The Journal of bone and joint surgery American volume. 2004;86-a(11):2464-70.
9. Hawker G, Wright J, Coyte P, Paul J, Dittus R, Croxford R, et al. Health-related quality of life after knee replacement. The Journal of bone and joint surgery American volume. 1998;80(2):163-73.
10. Jones CA, Voaklander DC, Johnston DW, Suarez-Almazor ME. Health related quality of life outcomes after total hip and knee arthroplasties in a community based population. J Rheumatol. 2000;27(7):1745-52.
11. Robertsson O, Dunbar M, Pehrsson T, Knutson K, Lidgren L. Patient satisfaction after knee arthroplasty: a report on 27,372 knees operated on between 1981 and 1995 in Sweden. Acta orthopaedica Scandinavica. 2000;71(3):262-7.
12. Nilsdotter AK, Toksvig-Larsen S, Roos EM. A 5 year prospective study of patient-relevant outcomes after total knee replacement. Osteoarthritis and cartilage. 2009;17(5):601-6.
13. Keurentjes JC, Fiocco M, So-Osman C, Onstenk R, Koopman-Van Gemert AW, Poll RG, et al. Patients with severe radiographic osteoarthritis have a better prognosis in physical functioning after hip and knee replacement: a cohort-study. PloS one. 2013;8(4):e59500.
14. WHO. How to use the ICF: A practical manual for using the International Classification of Functioning, Disability and Health (ICF). Exposure draft for comment. Geneva; 2013.
15. KNGF. KNGF-richtlijn: Artrose heup-knie. Nederlands Tijdschrift voor Fysiotherapie. 2010;120(1):7.