CHAPTER 10

Summary
HAND AND WRIST INJURIES ARE COMMON IN YOUNG NON-OSTEOPOROTIC PATIENTS AND RESULT MOSTLY FROM HIGH ENERGY TRAUMA. HOWEVER, LITTLE EMPHASIS HAS BEEN PLACED ON REPORTING HAND AND WRIST INJURIES IN THIS SPECIFIC YOUNG GROUP WITH HIGH DEMANDS OF THEIR HAND AND WRIST AND WITH A LONG ACTIVE AND WORKING LIFE AHEAD OF THEM. OUTCOME FOLLOWING THESE INJURIES CAN BE DESCRIBED USING RADIOLOGICAL MEASUREMENTS SUCH AS POSTTRAUMATIC ARTHRITIS (PA), CLINICIAN REPORTED OUTCOMES (CROs) SUCH AS RANGE OF MOTION AND GRIP STRENGTH, AND PATIENT REPORTED OUTCOMES (PROs) USING QUESTIONNAIRES. INSIGHT IN THE OUTCOMES FOLLOWING HAND AND WRIST INJURIES AND THE ASSOCIATION BETWEEN THESE DIFFERENT OUTCOMES COULD GUIDE TREATMENT AND REHABILITATION STRATEGIES IN THIS YOUNG NON-OSTEOPOROTIC PATIENT CATEGORY.

THIS THESIS REPORTED ON SEVERAL OUTCOMES FOLLOWING HAND AND WRIST INJURIES IN YOUNG NON-OSTEOPOROTIC PATIENTS AND PUTS THESE IN A CLINICAL PERSPECTIVE. PART 1 DESCRIBED RADIOLOGICAL MEASUREMENTS, CROs AND PROs FOLLOWING DISTAL RADIUS FRACTURES (DRFs) AND PERILUNATE (FRACTURE) DISLOCATIONS (PLD/PLFDs) IN YOUNG NON-OSTEOPOROTIC PATIENTS. FURTHERMORE, THE ASSOCIATION BETWEEN THESE OUTCOMES WAS ANALYSED. PART 2 EXPLORED THE VALIDITY OF SEVERAL PROs THAT MIGHT BE USED TO ANALYSE CONSEQUENCES OF HAND AND WRIST INJURIES.

PART 1 (CHAPTERS 2 – 5) OF THIS THESIS INVESTIGATED THE ROLE OF RADIOLOGICAL MEASUREMENTS, CROs AND PROs FOLLOWING DRFs AND PLD/PLFDs AND THEIR INTERRELATED ASSOCIATIONS. CHAPTER 2 IS A SYSTEMATIC REVIEW IN WHICH WE PROVIDED AN OVERVIEW OF LITERATURE ON THE ASSOCIATION OF PA WITH CROs AND PROs IN PATIENTS FOLLOWING DRFs WHO ARE OF NON-OSTEOPOROTIC AGE. IN ADDITION, WE AIMED TO PRESENT CURRENT KNOWLEDGE ON RADIOLOGICAL PREDICTORS FOR PA. PREVALENCE OF PA REPORTED IN ALL INCLUDED STUDIES WAS 50% AND 37% WHEN ANALYSING THE 10 STUDIES WITH OPEN SOURCE DATA. PA SEEMED TO PROGRESS OVER TIME WITH A STATISTICALLY SIGNIFICANT HIGHER PREVALENCE OF PA OF 64% AFTER FOLLOW-UP > 36 MONTHS VERSUS A PREVALENCE OF 31% WITH FOLLOW-UP DURATION ≤ 36 MONTHS. SIX STUDIES DESCRIBED A STATISTICAL SIGNIFICANT ASSOCIATION BETWEEN THE PRESENCE OF PA AND DIMINISHED FLEXION/EXTENSION. FROM THE OPEN SOURCE DATA WE CALCULATED THAT THE PRESENCE OF PA WAS ONLY RELATED TO A SIGNIFICANTLY DIMINISHED RADIAL DEVIAITION. NO ASSOCIATION BETWEEN PA AND GRIP STRENGTH SEEMED TO BE PRESENT. NO CONCLUSIONS COULD BE DRAWN REGARDING THE IMPACT OF PA ON PROs DUE TO LIMITED DATA. ONLY RESIDUAL ARTICULAR INCONGRUENCY COULD BE POINTED OUT AS A PREDICTIVE FACTOR FOR THE DEVELOPMENT OF PA.

IN CHAPTER 3 WE EXPLORED THE PREVALENCE OF PA AND THE ASSOCIATION OF PA WITH RADIOLOGICAL MEASUREMENTS, CROs AND PROs IN A COHORT OF 73 YOUNG NON-OSTEOPOROTIC PATIENTS FOLLOWING DRFs WITH A MEDIAN FOLLOW-UP OF 62 MONTHS. ALSO, WE AIMED TO ACHIEVE INSIGHT IN EMPLOYMENT CHANGES FOLLOWING DRFs. PA HAD A PREVALENCE OF 32% AND WAS STATISTICALLY SIGNIFICANTLY ASSOCIATED WITH LONGER RADIAL LENGTH, DIMINISHED FLEXION/EXTENSION AND Ulnar/Radial Deviation. Grip strength
was not associated with the presence of PA. Regarding the PROs, multiple statistically significant associations with PA were found; the Michigan Hand Questionnaire (MHQ) subscales ‘general functioning’, ‘esthetics’, ‘satisfaction’ and the total score as well as Short-Form36 (SF-36) subscales ‘physical functioning’ were all worse for patients with PA compared to those without PA. In regression analyses the Disability of Arm Shoulder and Hand questionnaire (DASH), Patient Reported Wrist Evaluation (PRWE) subscale ‘function’ and the total score of the PRWE were statistically significantly associated with flexion/extension. Ten per cent of patients stopped working or changed occupation because of the sustained DRF.

In Chapter 4 we compared the results of the radiological measurements of the same cohort of patients as described in Chapter 3 with error magnitudes and CROs and PROs with minimal important change (MIC) as reported in literature. In addition, associations between radiological measurements and outcomes were analysed. Although several radiological measurements evolved statistically significantly over time, none exceeded measurement errors. Regarding CROs following DRFs, flexion/extension, ulnar/radial deviation and pro/supination of the injured wrist were all significantly diminished compared to the uninjured wrist. Only MIC for flexion/extension and grip strength had been reported. The flexion/extension difference of 11.2° with the uninjured wrist exceeded MIC, while grip strength differences did not. MICs for DASH and PRWE have been reported in patients following DRFs, but not for MHQ nor for the SF-36 [1-3]. When comparing PROs in our population to PROs in healthy controls, the difference for the DASH did not exceed MIC, while the difference of the PRWE scores did. Furthermore, substantial differences between the DRF patients and healthy controls for MHQ subscales ‘general function’, ‘work’, ‘pain’, ‘satisfaction’ and total score and for SF-36 subscales ‘vitality’ and ‘pain’ were present. Unfortunately, no MICs have been published yet for the latter two PROs, which seems a shortcoming in interpreting these valuable outcome tools when reporting on hand and wrist injuries. Residual articular incongruency seemed to be associated with diminished range of motion. Also, a diminished SF-36 ‘mental component score’ seemed to be statistically significantly associated with residual articular incongruency. Further research is mandatory on MICs when reporting outcome following DRFs, to be able to interpret clinically relevant outcomes.

Chapter 5 focused on PLD/PLFDs, which are rare injuries presented in nearly the same age group as those who sustained a DRF (Chapters 2, 3 and 4). To gain insight in the influence of PLD/PLFDs on outcome the 11 included patients in this cross-sectional study were matched to 22 healthy controls. Patients experienced a significant impact on every day life with diminished range of motion (flexion/extension and ulnar/radial deviation), pain, diminished physical functioning, diminished satisfaction and they reported a lower general health status than healthy controls. Interestingly, no consequences for work participation were found in this small study.
In part 1 we emphasized that although several PROs are commonly used in reporting on outcomes following hand and wrist injuries, the interpretability and clinical relevancy are challenging. There is some variation in the psychometric properties of these instruments and the concepts measured are not always well defined. We think this might be due to insufficient validation for language and specific patient groups (target populations), but also due to a lack of knowledge on reference values, such as MICs for these instruments.

Therefore, in part 2 (Chapters 6 – 8) of this thesis we focused on specific PROs used to report outcomes following hand and wrist injuries and the validation of these instruments for Dutch patients with upper extremity injuries. In Chapter 6 we evaluated structural validity and construct validity using Confirmatory Factor Analysis (CFA) of the Dutch version of the DASH (DASH-DLV) for 370 patients with isolated hand or wrist injury. This study suggested that the DASH-DLV reflects a unidimensional trait. Thus, reporting on subscale scores is of very limited value and should be avoided. Further studies should asses the validity of the DASH-DLV in more detail, as well as other measurement properties to ensure reliable interpretation of this PRO in clinical practice.

The Dutch version of the PRWE (PRWE-NL) was previously validated by our research group using CFA and revealed that the PRWE-NL measures a unidimensional trait in Dutch patients with hand and wrist injuries [4]. This also suggests that a single score should be used for the PRWE-NL without reporting subscale scores.

As mentioned earlier, we face challenges in interpreting reported outcomes following hand and wrist injury with commonly used PROs due to variation in psychometric properties and measurements of unclearly defined constructs. In addition, completing (several) PROs is time-consuming for patients. Because of these challenges, the Patient-Reported Outcomes Measurement Information System (PROMIS) developed a series of item banks, including the PROMIS® Physical Function – Upper Extremity (UE) v2.0 [5,6]. The goal was to improve measurement quality, comparability of PROs across medical conditions and reduce patients’ burden [7]. The item bank will be used as a Computerized Adaptive Test (CAT) system using an algorithm that selects questions from the item bank based on patients’ response to previous questions. When a predefined precision is reached, the system automatically stops asking questions which reduces the number of questions that need to be asked.

In Chapter 7 the Dutch-Flemish PROMIS UE v2.0 (DF-PROMIS-UE v2.0) item bank was validated in 303 patients with upper extremity injuries by reporting on structural validity and construct validity using CFA. We showed that the DF-PROMIS-UE v2.0 item bank measures a unidimensional trait. Sufficient structural validity, internal consistency and construct validity were found.
To be able to use the DF-PROMIS-UE v2.0 CAT, successful validation and calibration with Item Response Theory (IRT) needed to be conducted, which was performed in Chapter 8. In a cohort of 521 patients with upper extremity injuries, the assumptions for fitting an IRT model were considered to be met. Therefore, the DF-PROMIS UE v2.0 item bank is considered to show sufficient evidence for unidimensionality, had negligible local dependence, good Graded Response Model (GRM) fit and demonstrated sufficient measurement invariance. The DASH displayed better reliability than the DF-PROMIS-UE 7-item short form and standard CAT and the QuickDASH showed comparable reliability. The MHQ-ADL displayed better reliability than the DF-PROMIS-UE v2.0 7-item short form and standard CAT for T-scores between 28-50. For patients with low function, the DF-PROMIS-UE v2.0 measures performed better. In addition, the DF-PROMIS-UE CAT is on average more efficient than the DF-PROMIS-UE full bank and 7-item short form and more efficient than the DASH, QuickDASH and MHQ. The DF-PROMIS-UE v2.0 is now ready for use as CAT in research and clinical practice. CAT reduces the number of questions that need to be answered and therefore diminishes the burden for patients.

In Chapter 9 we provided an overview of the research presented in this thesis. We have shown that hand and wrist injuries can evolve in major life events for patients, due to possible impairment in daily life. Therefore, for clinical practice, the organisation of a specialized team dedicated to hand and wrist injuries including trauma surgeons, orthopaedic surgeons, plastic surgeons, rehabilitation physicians, radiologists and hand therapists is advised. We propose a 'lean' version of the described core set of measures for clinical practice [8,9] with known MICs to interpret clinical relevant change; flexion/extension, ulnar/radial deviation and either the DASH or PRWE. Validation of the Dutch translated version of the MHQ and SF-36 was advices. In the near future, we aim to report on MICs for the DASH, QuickDASH, PRWE, MHQ, SF-36 and DF-PROMIS-UE v2.0 item bank for young non-osteoporotic patients following hand and wrist injury. This will enable implementation of low burden PROs in 'lean' core sets to interpret outcome in clinical practice.
REFERENCES


