# Prognostics of recovery in hip fracture patients

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# Summary

Proximal femoral fractures (often denoted as hip fractures) are amongst the most prevalent fractures in older patients. These fractures are associated with significant mortality and morbidity. Failure to recover to prefracture levels of function has important social and economic implications, as these patients risk losing their independence and self-reliance. Prognostication is of clinical importance as it helps to determine treatment strategies. Interventions could be developed and applied for modifiable risk factors of adverse outcomes. Alternatively, non-modifiable factors are important for the prognostic accuracy, which helps to shape expectations and steer advance care planning. The enormous heterogeneity in the health status of older patients makes prognostic efforts very challenging.

The primary aim of this thesis is to provide a better understanding of the factors relevant for the functional prognosis of patients with a proximal femoral fracture.

This thesis covers two parts which focus on the effects of surgical aspects and patient demographics. The studies presented in part one describes the different surgical approaches for arthroplasty in femoral neck fractures. Part two includes studies which focus on the methods to assess patient demographics and their relevance towards functional outcome.

In *Chapter 2* a meta-analysis compares the outcomes of the three major surgical approaches for hemiarthroplasty in patients with a femoral neck fracture, these being the anterior approach (AA), lateral approach (LA) and posterior approach (PA). Each is considered a viable approach for routine care with no consensus on the superiority of one. Twenty-one eligible studies, comparing at least two of these approaches, were included. A significantly higher risks of dislocations for the PA was indicated. No significant differences were found concerning perioperative fractures, wound infections, and hospital length of stay. Only limited and heterogenous data was available on the functional outcomes of each approach. Some studies suggest a better short-term functional outcome using the AA compared to the PA, but this was not conclusive.

In *Chapter 3*, a prospective observational cohort study compares the application and surgical outcomes of the AA with the LA. Both approaches are routinely used for arthroplasty in the study hospital. Significant differences were observed in the baseline characteristics of patients treated with the AA and LA, mostly associated with the more frequent use of THA in the AA group. The overall incidence of surgical complications was 7.8% and 8.1% for the AA and LA respectively and did not differ significantly. A significantly longer operation time and more blood loss was observed for the AA, but this was not considered clinically relevant or confirmed by the majority of previous studies.

Two screening tools routinely used during admission of acute medical patients, the SNAQ and MNA-SF were compared in a cross-sectional study to assess their screening capacity the ESPEN

criteria as the golden standard of the nutritional status (*Chapter 4*). The negative effects of malnutrition are well studied, including its effect on the outcomes of hip fracture surgery. The prevalence is considered very high in this older patient population, and further deterioration of the nutritional status can be provoked by factors associated with acute care and a lengthy rehabilitation process. In this study 16.9% of all patients was diagnosed as malnourished by the ESPEN criteria and 20.1% to 47.8% were classified as either at risk for malnutrition or as malnourished by the SNAQ and MNA-SF respectively. A moderate agreement was found between the tools (k = 0.68), and while the SNAQ was proven to be a very specific screening tool, 28.4% of all malnourished patients with a proximal femoral fracture had a false negative outcome. Consequently, no benefits were observed for the SNAQ over the MNA-SF, as consequent under treatment of fragile older patients should be avoided.

In a systematic review which included 31 studies on the independent factors associated with long-term functional outcome, thirteen factors were studied (*Chapter 5*). The current understanding of prognostic factors of functional recovery after a proximal femoral fracture is limited, and enhancements could improve the prognostic accuracy and target subgroups for additional care strategies. Of the studied factors, only age, comorbidity, functionality and cognition had a substantial level of evidence supporting a significant effect. The remaining factors (including residence and social status, ethnicity, psychological status, nutritional status, vitamin D, fracture type, delay in surgery and complications) had not. None of the available data could be pooled due to the enormous heterogeneity in the definition of successful recovery and the methods to assess patient demographics. This highlights one of the major challenges in this field of research.

The study described in *Chapter 6* is a prospective observational cohort study of community dwelling patients, and their transitions through different states of the recovery process. A multi-state model was used to define each state and transition, which enables visualization of the population phasing from treatment to their final endpoint. Of all patients, 65.5% returned to independent living with recovered levels of independence in ADL within the 3-month follow-up. Factors that were deemed significantly associated with a successful recovery of independence for patients who succeeded to return to independent living, included: general health status, prefracture mobility, prefracture independence and fear of falling. Factors including cognition, nutritional status and anaemia were not. Novel applications of the multi-state model are suggested for further studies.

*Chapter 7* describes the design of a prospective observational inception cohort study including premorbid community dwelling patients with a proximal femoral fracture. The aim of the study is to identify independent prognostic factors of functional recovery with an emphasis on the nutritional status and sarcopenia using handgrip strength and fat-free mass index assessments. Functional recovery is defined using a composite outcome of the patient's survival, living situation and individual functional recovery assessed at 6 weeks, 3 months and 1 year after surgery.

In *Chapter 8*, the prognostic value of a previously constructed mortality risk score, composed of 14 biomarkers, is tested on a cohort of patients with a proximal femoral fracture with a me-

dian follow-up of 6 months. Within this period, 19.0% of all patients died, and 47.7% returned to prefracture levels of independence in ADL. The mortality risk score, originally designed for general populations with a long-term follow up, had a significant association with mortality in this population also (HR, 2.68) and a fair prediction (AUC = 0.682). No such association was observed between the mortality risk score and functional recovery of patients. Although the potential for prognostic value was observed, more elaborate studies are needed to validate these findings and to develop a comprehensive model for clinical purposes.

Although some benefits of the anterior approach have been observed concerning the complication rate and functional, mayor clinically relevant differences such as better or shorter recovery are lacking. There are substantial barriers to adopt the surgical approach, with a shallow learning curve and risks of peroperative complications.

Interpretation of the findings on factors relevant for the functional prognosis of patients with a proximal femoral fracture has proven to be challenging. This field of research is characterized by little homogeneity in the methodology of different studies. Factors which seem relevant for virtually all versions of functional outcome and most subgroups of patients with proximal femoral fractures are comorbidity and prefracture functionality. This highlight the importance of a holistic and geriatric approach in patients with proximal femoral fractures. This warrant close examination of patients and endorses the importance multidisciplinary rehabilitation. Loss of function and independence have major social and economic consequences, and this patient population is at high risk.

We have suggested a novel composite outcome to study recovery, which defines three aspects of independency, these being the return to prefracture levels of independence in ADL, the return to independent living, and survival. It can be used to assess whether patients have returned to their individual prefracture level of independence. This outcome is patient-cantered and seems feasible in routine care settings.