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Challenges and opportunities in trauma research: study designs and patient-reported outcome measures

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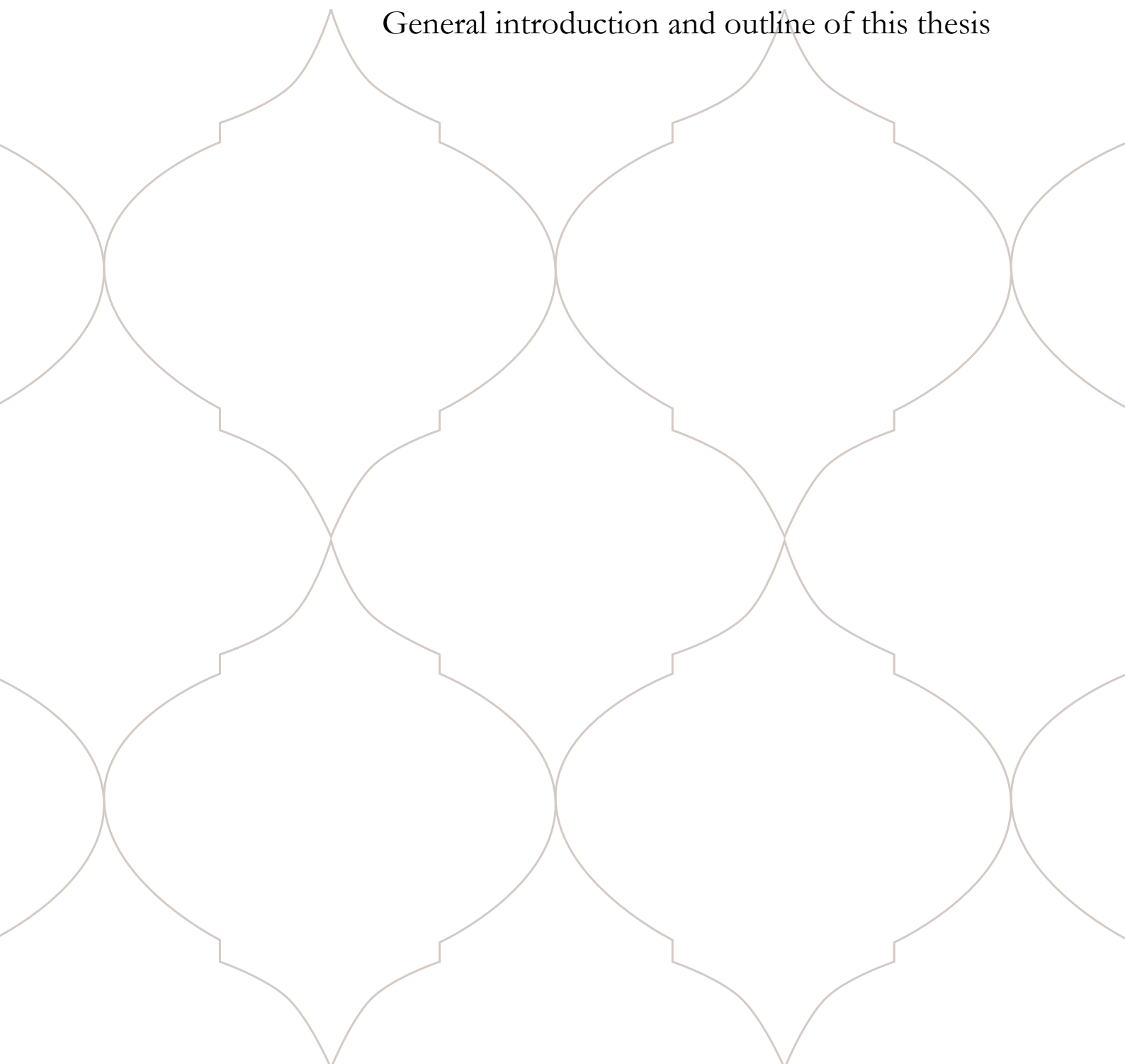
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CHAPTER 1

General introduction and outline of this thesis



Challenges in trauma research

Evidence-based medicine, using the best available research evidence to guide clinical decision making, offers both opportunities and challenges. In the field of orthopedic trauma surgery, great progress has been made in the understanding of fracture healing, immune response, timing of interventions, and development of implants.¹ However, musculoskeletal injuries are still a major global health problem, contributing a large burden of disability and suffering.² Although injury-related mortality rates have declined over the last decades in many high-income countries, in 2013 injuries still accounted for 10% of the global burden of disease, with a loss of 248 million disability-adjusted life-years.³

Improved patient care has enhanced the likelihood of surviving serious injury. As a result, focus has shifted to improving quality of survival and reducing the burden of nonfatal injury.³ However, research-based advances that improve these outcomes for patients with major orthopedic injuries have been constrained by two important factors; inadequate high-quality studies in the field of orthopedic trauma surgery, and insufficient attention to patient-reported outcome measures (PROMs).¹

Study designs in trauma research

The first challenge is the lack of high-quality studies of surgical and non-surgical interventions in orthopedic trauma patients. Although randomized controlled trials (RCTs) are considered the highest level of evidence, this design might not always be ethical, feasible, or necessary to address a specific surgical research question. These challenges are especially apparent in the surgical field, with acute and urgent life-threatening situations such as trauma surgery. In this field variation in surgical practice can lead to practical and methodological difficulties in terms of patient recruitment and randomization.⁴ In fact, a literature review revealed 21% of surgical RCTs are discontinued and 33% of trials remain unpublished after a median of 4.9 years. These challenges have led to a growing debate on the need of RCTs for the evaluation of surgical interventions, and whether well-designed observational studies might complement and add valuable information to results from RCTs.^{5,6}

Importantly, more than 80% of orthopedic surgical trials are methodologically limited by small sample sizes, inadequate allocation of concealment, and no independent assessment of outcomes. The small sample sizes and low quality of studies have restricted the translation of studies to

routine patient care.¹ Furthermore, RCTs can have strong internal validity, however, their external validity (generalizability of results) tends to be low. The patient populations encountered in daily clinical practice can differ from the often highly selected patient populations enrolled in RCTs.⁷ Moreover, RCTs might not have sufficient follow-up or sample size to assess infrequent outcome measures or long-term treatment effects.^{8,9} Finally, RCTs are accompanied by the need for substantial resources and are therefore not always justified for questions regarding small modifications to a treatment or technique, which are typical for the surgical field.¹⁰ Given the limited added value of surgical trials (no concealment of allocation and blinding of outcome assessor) and need for substantial recourses, observational studies may provide an alternative to assess effects of surgical and non-surgical interventions in orthopedic trauma patients, provided such studies are of sufficient quality.⁴ The potential added value of observational studies might differ between different comparisons and research questions.⁴ In a health care system with growing financial burden, the relative low cost and feasibility underline the possible added value of observational studies.

Meta-analyses are valuable tools for the assessment of differences in treatment effects. Currently, both RCTs and observational studies are increasingly used in orthopedic trauma meta-analyses for the evaluation of treatment effects. Provided that observational studies are of high quality, adding information from observational studies to meta-analyses could increase sample size, which could enable the evaluation of small treatment effects and infrequent outcome measures. Furthermore, observational studies might provide insight into a variety of populations, subgroups, and long term effects, therefore having a role in improving the value and best available evidence in orthopedic trauma care.^{4,6,11}

Patient-reported outcome measures

Over the last decades, focus has shifted from a volume to a value-based health care system. In the value-based system, achieving high value for patients must become the goal of health care, with value defined as patient relevant health outcomes, relative to the costs of medical care. The relevant health outcomes, which define the value in the equation, are inherently condition-specific and multidimensional.¹² With the shifting focus towards a value-based health care system there is also a shift from physician-reported to patient-reported outcome measures (PROMs). Moreover, while health care evolves from volume to value, there is increasing interest by payers to use patient-reported outcomes to determine value and more specifically, quality from the

patient's perspective.¹³ Standardized outcome measures and routine collection of PROMs are needed to monitor and assess present and new treatment approaches and to support clinical trials and evidence-based care.¹

In the past, research primarily focused on clinical and radiological outcomes and by doing so overlooked the quality of life of surviving patients.¹ Modern trauma care systems consider the recovery of patients from injury through prehospital care, acute care, and rehabilitation. However, the understanding of the degree of recovery, the time needed, and the proportion of the injured population who will experience lifelong disability is limited. Outcome studies are mainly single center, include small samples, and/or are limited to a single moment of short-term follow-up. Multicenter studies that evaluate multiple time points after injury, important for establishing the long-term burden of injury to provide information about prognosis, and guiding treatment decisions are lacking.³

Reports suggest that the use of PROMs has rapidly increased over the last decades and it has been noted that this trend will continue. However, despite the advances and use in routine care, there are still substantial challenges regarding implementation and standardization of PROMs. These challenges include the reliability and precision of the instruments used to capture the outcome of interest. Previous orthopedic studies, evaluating similar conditions, have used a variety of different “traditional” legacy PROMs, making it difficult to compare results. Moreover, the completion of the previous legacy measures can be burdensome and time consuming. Hence, the challenges are how to compare outcomes score between groups and studies, and how to increase the effectiveness of measuring different health outcomes, while reducing administration time and lowering responder burden for PROMs.¹⁴⁻¹⁶

Standardized quality measurements have been difficult to implement for the orthopedic trauma population since there is an almost innumerable combination of injuries secondary to different mechanisms and contexts.¹⁷ The patients in orthopedic trauma care are heterogeneous and their care is complex, thus established methods for measuring outcomes for elective orthopedic procedures are unlikely to translate easily. A common framework for judging post-intervention patient-reported outcome for elective procedures is comparison to pre-operative function. However, because pre-injury status for trauma patients is often unclear and subject to recall bias, this framework is difficult to apply without additional assumptions that vary by patient and injury

context. As a result, these factors make implementation of value-based care models for trauma patients particularly challenging. In this context, less is known about outcome measures and quality when evaluating trauma.¹⁷ Future studies are required to determine which specific quality measures to institutionalize, how to modify them for different injury contexts, and then how to incorporate them into new payment models. In addition, benchmark studies will only produce valid results if adjustments for injury severity and other injury specific covariates are performed.¹⁷

Aims and outline this thesis

Evidence-based medicine in the field of orthopedic trauma surgery is constrained by two important factors, a lack of high-quality studies and insufficient attention to patient-reported outcomes. To improve the prognosis of orthopedic trauma patients, additional research is needed into the value of different study designs which evaluate the effects of new and existing medical interventions for trauma patients in everyday clinical practice. Also, assessment of the use of PROMs as an integrated part of research practice. The studies presented in this thesis aim to contribute to these two ambitions.

The potential added value of observational studies in orthopedic trauma will be evaluated in **Part 1**. In **Chapter 2**, the potential value of routinely collected data on elective surgical interventions is assessed. **Part 1** also describes four meta-analyses, which included both RCTs and observational studies, of surgical and non-surgical interventions in patients with proximal humeral fractures (**Chapters 3**), humeral shaft fractures (**Chapter 4**), distal radius fractures (**Chapter 5**), and Achilles tendon ruptures (**Chapter 6**), respectively.

Part 2 of this thesis focuses on patient-reported outcome measures. Specifically, the value is assessed of a tool to measure patient-reported outcomes, the PROMIS tool, in comparison to established measurement tools including the shortened version of the Disabilities of the Arm, Shoulder and Hand questionnaire (QuickDASH) in trauma patients. **Chapters 7** and **Chapter 8** describe two benchmark studies that assess the effects of new and existing medical interventions with the use of the QuickDASH scores for two injuries, acromioclavicular joint dislocations and lateral clavicular fractures. Studies presented in **Chapters 9** and **Chapter 10** assess the use of the PROMIS and the QuickDASH scores and explores the association between these PROMs and clinical outcomes in proximal humeral fractures and distal humeral fractures, respectively. **Chapter 11** establishes normative data on the long-term patient-reported functional outcome and

health-related quality of life after surgical treatment of bicondylar tibial plateau fractures. The study described in **Chapter 12**, looks into the relation between the PROMIS tool and the Achilles Tendon Total Rupture Score (ATRS) in patients undergoing treatment for acute Achilles tendon ruptures. This thesis ends with a general discussion including recommendations and directions for future research (**Chapter 13**).

References:

1. Balogh ZJ, Reumann MK, Gruen RL, et al. Advances and future directions for management of trauma patients with musculoskeletal injuries. *Lancet (London, England)*. 2012;380(9847):1109-1119.
2. Mock C, Cherian MN. The global burden of musculoskeletal injuries: challenges and solutions. *Clin Orthop Relat Res*. 2008;466(10):2306-2316.
3. Gabbe BJ, Simpson PM, Harrison JE, et al. Return to Work and Functional Outcomes After Major Trauma: Who Recovers, When, and How Well? *Annals of surgery*. 2016;263(4):623-632.
4. Houwert RM, Beks RB, Dijkgraaf MGW, et al. Study methodology in trauma care: towards question-based study designs. *Eur J Trauma Emerg Surg*. 2019.
5. Chapman SJ, Shelton B, Mahmood H, Fitzgerald JE, Harrison EM, Bhangu A. Discontinuation and non-publication of surgical randomised controlled trials: observational study. *Bmj*. 2014;349:g6870.
6. Beks RB, Bhashyam AR, Houwert RM, et al. When observational studies are as helpful as randomized trials: Examples from orthopedic trauma. *The journal of trauma and acute care surgery*. 2019;87(3):730-732.
7. Van Spall HG, Toren A, Kiss A, Fowler RA. Eligibility criteria of randomized controlled trials published in high-impact general medical journals: a systematic sampling review. *Jama*. 2007;297(11):1233-1240.
8. Frieden TR. Evidence for Health Decision Making - Beyond Randomized, Controlled Trials. *The New England journal of medicine*. 2017;377:465-475.
9. Arditì C, Burnand B, Peytremann-Bridevaux I. Adding non-randomised studies to a Cochrane review brings complementary information for healthcare stakeholders: an augmented systematic review and meta-analysis. *BMC health services research*. 2016;16:598.
10. McCulloch P, Taylor I, Sasako M, Lovett B, Griffin D. Randomised trials in surgery: problems and possible solutions. *Bmj*. 2002;324(7351):1448-1451.
11. Rouleau DM. Designing clinical studies in orthopedic traumatology. *Orthopaedics & traumatology, surgery & research : OTSR*. 2018;104(1s):S1-s7.
12. Porter ME. What is value in health care? *N Engl J Med*. 2010;363(26):2477-2481.
13. Lowry KJ, Brox WT, Naas PL, Tubb CC, Muschler GF, Dunn W. Musculoskeletal-based Patient-reported Outcome Performance Measures, Where Have We Been-Where Are We Going. *J Am Acad Orthop Surg*. 2019;27(13):e589-e595.
14. Brodke DJ, Saltzman CL, Brodke DS. PROMIS for Orthopaedic Outcomes Measurement. *J Am Acad Orthop Surg*. 2016;24(11):744-749.
15. Cheung EC, Moore LK, Flores SE, Lansdown DA, Feeley BT, Zhang AL. Correlation of PROMIS with Orthopaedic Patient-Reported Outcome Measures. *JBJS reviews*. 2019;7(8):e9.
16. Gagnier JJ. Patient reported outcomes in orthopaedics. *Journal of orthopaedic research : official publication of the Orthopaedic Research Society*. 2017;35(10):2098-2108.
17. Bhashyam AR, van der Vliet QMJ, Ochen Y, et al. Injury-related variation in patient-reported outcome after musculoskeletal trauma: a systematic review. *Eur J Trauma Emerg Surg*. 2019.