Aspects of Mental Health in Amputees during Orthopedic Rehabilitation

Changes in Mental and Physical Parameters

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Submitted by
Mag.rer.nat. Chaska Malena Armbruster

Senior Supervisor
Univ. Prof.in Dr.in Anita Holzinger MPH
Medizinische Universität Wien
Währinger Gürtel 18-20, 1090 Wien
e-mail: anita.holzinger@meduniwien.ac.at

Junior Supervisor
Prim. Priv.Doz. Dr. Stephan Domayer, PhD, MBA
Orthopädisches Rehabilitationszentrum Zicksee
Otto-Pohanka-Platz, 7161 St. Andrä
e-mail: stephan.domayer@skazicksee.at

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Declaration

Herewith, I confirm that the research and analyses were done at the following institution:

a) Orthopedic Rehabilitation Center Sonderkrankenanstalt Zicksee (St.Andrä/Burgenland)

The studies were conducted with the support of my Junior Supervisor Prim. Priv.-Doz. Dr.med. Stephan Domayer, MBA.
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Objective: The main objective of this doctoral thesis was to investigate and analyze parameters of mental and physical health during the course of orthopedic inpatient rehabilitation in an amputee population. It was presumed that the state of mental health (body image, depression, health-related quality of life) of amputees at admission would be notably lower compared to the control group (total arthroplasty patients) and that mental health would improve significantly throughout the course of the stay. Another objective was to prove that transtibial amputees would show a better health state regarding mobility, prosthesis use, activities of daily living, pain, and health-related quality of life compared to transfemoral amputees at admission and throughout the course of rehabilitation.

Methods: During the lapse of one year, data of a total of 104 patients was collected. After excluding data of 7 patients due to illness and sample homogeneity, the amputee group included 50 participants, and the control group 47 total arthroplasty patients. Selected questionnaires and tests were completed at the beginning of the inpatient rehabilitation stay (3-4 weeks) and repeated at discharge. Mental health parameters were evaluated using the Frankfurt Body Concept Scales (FKKS) and a depression questionnaire (BDI-II). Health-related quality of life was measured using the questionnaires SF-36 and EQ-5D. Furthermore, standardized measurements of amputees' recovery parameters (6MWT, TUG, 10mWT, Houghton Scale, Barthel Index, pain) were carried out at admission and discharge of rehabilitation. The return rate was 97.1 %.

Results: Amputees showed no difference in mental health compared to total arthroplasty patients at admission. However, they could significantly increase their mental health throughout the course of rehabilitation. Transtibial and transfemoral amputees differed most significantly regarding walking abilities and pain.

Conclusion: The results of this doctoral thesis provide new insights to the field of mental health and amputee rehabilitation during the orthopedic rehabilitation process. The present data can provide a basis for future studies in amputee rehabilitation.
Abstract German


**Abbreviations**

6MWT = 6 Minute Walk Test

10mWT = 10 Meter Walk Test

ADL = activities of daily living

BDI-II = Beck’s Depression Inventory

DM = diabetes mellitus type II

HRQOL = health-related quality of life

LLA = lower limb amputation/ amputees

MH = mental health

PAOD = peripheral arterial occlusion disease

PH = physical health

PLP = phantom limb pain

PMR = progressive muscle relaxation

QOL = quality of life

TAP = total arthroplasty patients

TFA = transfemoral amputees

TTA = transtibial amputees

TUG = Timed Up-and-Go Test
I. THEORETICAL PART

1. INTRODUCTION

Amputation has a strong impact on an individual’s life. Provided that the amputation cause is not induced by an accident or trauma, typically a long and ongoing course of disease precedes amputation impairing physical health. Moreover, an amputation also has an essential impact on mental health.

Mental health recovery has been found to be important during physical rehabilitation (Pezzin et al., 2013). Common mental impairments after amputation can be body image disorders, affective disorders or reduced quality of life. Also pain perception plays an important role for the psychological treatment, since pain is an important factor in the development and onset of psychological diseases (Hoffman et al., 2007). Health-related quality of life (HRQOL) includes the perception of physical and mental health over time and is therefore taken as another important parameter for the evaluation of mental health during physical health recovery. Although it has become a quality standard to offer psychological services and interventions during amputee rehabilitation as part of the rehabilitation process, there is only a limited number of research papers on mental health available (Asano et al., 2008; Willrich et al., 2005), and little is known about mental health and HRQOL during physical rehabilitation after amputation (Zidarov et al., 2009; Zweynert et al., 2009).

For analysis of amputees’ health, there are different classifications being used (e.g. lower limb and upper limb, vascular and non-vascular, transtibial and transfemoral). This allows a comparison of differences in research outcomes. For lower limb amputees (LLA), the amputation level is a decisive factor influencing many outcome measures in daily living. Therefore parameters such as mobility, prosthesis use, or activities of daily living are vital to be enhanced during physical rehabilitation for this population.

The focus of this thesis was on the impact of an orthopedic rehabilitation stay on mental health and HRQOL, and in addition, to analyze important health recovery outcomes for amputees and compare them with total arthroplasty patients (TAP). As a pilot study, the results focus on short-term effects and the relation between the outcome and different recovery-related variables. The results give new insights into the research field of amputee mental healthcare.
BACKGROUND

2. Amputation

Amputation is defined as removal of a limb in the osseous part and needs to be distinguished from the procedure of exarticulation (Crevenna, 2016). With regard to historic records, amputation is one of the eldest known healing methods in medicine. Since the focus is on the healing function of an amputation, rehabilitation has become an important part of medical treatment. One of the most monumental steps in amputation history was the work of French surgeon Ambroise Paré who used a newly developed technique to reduce blood loss during an amputation. Further development in amputation techniques are shown in figure 1.

Figure 1


For a long time, diseases or infections were the main causes for amputation, such as diseases transmitted by animals or gangrenes during wars. Improved theories on sepsis and antisepsis by Pasteur (Kempker & Martin, 2016) helped to further develop and significantly improve surgery methods impacting health and survival outcomes. After the
two world wars, surgery and rehabilitation received a new meaning in primary health care: once a standardized amputation procedure was implemented, the focus of attention turned to rehabilitation of amputees. Rehabilitation not only included to regain the ability to walk and wound healing, but also prosthetic supply and care. Regarding prosthetics, modern techniques nowadays enable patients to develop a close to normal movement routine. Nevertheless, an optimal prosthesis use depends on patients’ health status. Furthermore, highly developed prostheses are expensive and therefore almost impossible to afford, since insurances or public health services may not cover the costs. Nowadays, amputation surgery is standardized, and also rehabilitation methods follow a standardized procedure. Vascular diseases have the highest prevalence in Western countries, e.g. peripheral artery occlusion disease (PAOD) and diabetes mellitus (DM), which face a steadily increasing prevalence due to unhealthy lifestyle (Fowkes et al., 2013). In a study about amputation incidence in the Netherlands (Fortington et al., 2013), the incidence for amputations due to vascular diseases was calculated with 8.8 (across all age groups) per 100,000 persons, and the risk for patients to be amputated was twelve times higher than for patients without vascular disease.

2.1. Amputation Causes

*Diabetes Mellitus*

According to the American Diabetes Association ADA (2014), diabetes mellitus (DM) is classified into three types, DM type 1, type 2, and other specific types (e.g. genetic defects, endocrinopathies, or infections). The focus in the thesis is on DM type 2 as it includes about 90 % of individuals with diabetes, and is therefore the main cause for an amputation (Chen et al., 2012). Similar to DM type 1, in DM type 2 heredity transmission plays an important role. If one of the parents develops DM, the risk to inherit diabetes is 40 %. If both parents have DM type 2, the risk of inheriting DM is 80 % (Hien et al., 2014). DM is linked to an increase in small (microvascular) and large (macrovascular) vessel diseases. The macrovascular effects that diabetes has can cause morbidity and is also found in peripheral vascular complications which can ultimately lead to amputation. A manifestation of DM usually occurs if a genetic constellation is paired with a disadvantageous lifestyle (Martin-Timon et al. 2014). The cause for a disadvantageous lifestyle is high caloric or unhealthy nutrition, a lack of exercise or substance abuse. DM is mainly associated with obesity and cardiovascular factors such as hypertension, but also abnormalities of the lipoprotein metabolism (Martin-Timon et al., 2014).
PAOD (peripheral arterial occlusion disease)

Arterial occlusion is a systematic disease of arteries which is caused by atherosclerotic constriction of the vessels. The insufficient blood supply can cause pain, which is known as intermittent claudication (Criqui & Aboyans, 2015). If different risk factors of cardiovascular health issues exist, the risk of developing a peripheral arterial occlusion disease is a few times higher (Fowkes et al., 2013). According to ICD-10, atherosclerosis is a disease of the elastic arteries such as the muscular type arteries, and is defined as "a variable combination of changes of a focal accumulation of fatty substances, complex carbohydrates, blood and blood components, tissue and calcium deposits, associated with changes in the arterial media". The measurement of blood pressure at the ankle led to the development of the ankle-brachial index (ABI). It is defined as ratio of the systolic blood pressure at the ankle to that in the arm. An abnormally low value of ABI is indicative of atherosclerosis in the leg (Criqui & Aboyans, 2015). Main risk factors for a PAOD are: hypertonia, nicotine consume, diabetes mellitus, and lack of movement and obesity (Criqui & Aboyans, 2015). Other risk factors are age, gender and stress (Danese et al., 2005).
**Sepsis**

An infection or sepsis is still a major health problem in industrialized as well as in developing countries and correlates with a high mortality rate of 29% according to Stevenson et al. (2014). There is a controversy regarding the definition of sepsis, but in simplified terms it is described as a systemic inflammatory response (Baudouin, 2009). Although it is difficult to find a global explanation for the etiology of sepsis, an increase of sepsis in hospitalized patients has been observed (Vincent et al., 2006). It is mainly occurring in the elderly population with chronic diseases who have been undergoing invasive procedures (Jarman et al., 2004). A sepsis often occurs in patients with diabetes, or a diabetic Charcot foot. In many cases, surgery and/or amputation is the last option to save patient’s life.

**Accident/ Trauma**

Enhanced security systems like airbags, seat belts or trainings for safety at work have led to a lower incidence of non-fatal injuries with a prevalence of 3.9% (Raina et al., 2016). Therefore, accidents are only a small part of amputation causes, except for the military context where traumatic amputation plays a major role (Staruch et al., 2016). Accidents in general can be grouped into primary and secondary amputation causes: In primary amputation, a separation of the limb already has taken place. In some cases, and if a surgeon reacts fast enough, a replantation is possible. Secondary amputations span a longer time period since the time span between the accident and the definite procedure of amputation can be weeks, months or even years. Depending on the amputation cause, trauma amputee patients are often younger than other amputee groups, and predominantly male (Varma et al., 2014). Younger age offers a chance to better reintegrate trauma amputees into daily living routines due to a better prosthesis handling, but also offers a higher prevalence for a decreased mental health (Melcer et al., 2013) and an impaired HRQOL (Hammarlund et al., 2011).

**Bone tumors**

In ICD-10, bone tumors are classified as malign (C0, C41, C79.5) or benign (D16, D48). Bone tumors can be divided into two categories: primary bone tumors and secondary bone tumors. Primary bone tumors normally affect directly bone tissue, whereas secondary bone tumors are metastases of tumors which are originally located in other parts of the body. According to Varma et al. (2014), primary malignant bone tumors represent 6% of all cancers of children under the age of 20 in the United States. The
most common bone tumors are osteosarcoma, Ewing sarcoma and chondrosarcoma. *Osteosarcoma* is the most common primary malign bone tumor. *Ewing sarcoma* is the second most common bone tumor and it appears most commonly at an early age (between 5 and 27 years). It is mostly located in the diaphysis of long bones, femur or tibia. The Ewing sarcoma normally spreads to other bones or to the lung. Osteosarcoma and Ewing sarcoma are the two predominant bone malignancies (Varma et al, 2014). *Chondrosarcoma* is a malign bone tumor with a location where cells produce cartilage but no bone substance. It is most common in male adults and often located in the femur and pelvis area. The most common benign bone tumor is the *osteochondroma*. It is mostly observed in the neoplasm or the skeleton. In relation to other amputation causes, bone tumors only form a small percentage of amputations: Smith et al. (2017) identified an overall rate of 4.1 % in primary localized sarcoma.

### 2.2. Post-amputation Pain

*Phantom limb pain (PLP)*

PLP is a well-researched topic (Bosmans et al., 2010; Casale et al., 2009). It is defined as pain in the non-existing limb and according to ICD-10 is classified as a neuropathic pain which needs to be distinguished from phantom limb sensation. Literature differentiates between painful and non-painful phantom sensations (Flor, 2002). Analyzing research literature about PLP, the percentages of patients reporting PLP differ widely. The range of patients reporting PLP is normally around 50 – 80 % (Flor et al., 2006). Research tends to findings that protective factors to avoid PLP are: being male, having a lower limb amputation and time elapsed since amputation (Bosmans et al., 2010). However, results for long-term outcomes are still not homogenous. Research of PLP etiology has come up with different theories: the theory of Melzack (1989) of neuronal matrix was determinant in past decades. The most established one in the last decade however was the theory of Flor (2008) of cortical reorganization which suggests that amputation is associated with neuro-plastic changes in sensory and motor cortices.

*Stump pain*

Stump pain is defined as pain sensation located directly on the stump area due to local changes in skin, i.e. infection on skin, bone or tissue. Scars, neuroma, neuropathic pain, and malposition of prosthesis fit can be further causes for this kind of pain. There is a distinction between acute and chronic stump pain. Stump pain after amputation is reported in around 50 % of patients (Kooijman et al., 2000).
**Back pain**

Once amputees regain a certain level of health, walking with crutches is a significant part of rehabilitation. It is likely that amputees develop problems in their back as a secondary effect of disability (Morgenroth et al., 2010). Therefore, back problems are being considered as adverse effect of an amputation. Ephraim et al. (2005) analyzed patients after amputation and 62.3% reported back pain after amputation. In an internal clinical evaluation of the Department of Orthopedics at the Vienna General Hospital, led by the author of the thesis, retrospective data of more than 400 patients was analyzed regarding post-amputation pain. Pain (phantom limb pain, stump pain, back pain) was a dominant factor after amputation (66%). Coping behavior, depressive symptoms, substance abuse, and the financial situation were significantly influenced by pain phenomena. A significantly positive correlation between increased PLP and increased depressive symptoms could be observed.

**3. Orthopedic Rehabilitation Standards**

Physical rehabilitation is the main pillar of recovery. As a general term it is defined as “a problem-solving and educational process aimed at reducing the disability experienced by someone (with physical impairment) as a result of a disease, but always within the limitations imposed by available resources and by the underlying disease” (Wade, 1992).

The model which is nowadays used by the WHO for classifying diseases is the ICF (International Classification of Functioning, Disability and Health). With the ICF, a model, classification and thus conceptual basis for understanding functional capability and disability has been contributed. Within not even ten years, it has been broadly established in the rehabilitative context (Cerniauskaite et al., 2010).

According to the WHO (Gutenbrunner et al., 2010), physical and rehabilitation medicine is classified in three parts: acute services (rehabilitation in hospital), post-acute services (inpatient rehabilitation services), and long-term services (outpatient rehabilitation services). Focusing on inpatient rehabilitation, orthopedic rehabilitation is needed to regain vital functions for the daily living routines, and enables patients to re-learn walking abilities, to reduce pain sensation and to exercise and rebuild muscular strength. Orthopedic rehabilitation furthermore focuses on the (re-)stabilization of different movement segments, strengthening of muscles and muscle groups, increasing function
of joints, optimization of coordination and condition, regaining of activities of daily living (ADL), psychological stabilization, and general health trainings (Ip, 2007).

Indications for an admission to an orthopedic rehabilitation are primarily surgeries in shoulder, hip, knee, joints, or column. Also, fractures or a rupture of the ligament can be a reason for rehabilitation. Before initiating the rehabilitation stay, patients need to be tested regarding their individual rehabilitation abilities: postoperative wounds, conditions with evidence of local infection, extensive autonomy for the main ADL (Barthel-Index of at least 35 points) (Stein & Greitemann, 2015), sufficient and safe mobility at least for ambulation on level surfaces (possibly with the aid of crutches), sufficient personal motivation for rehabilitation, and adequate cognitive abilities (Ip, 2007).

Therapy methods include the prescription of medication, physical therapy methods, rehabilitation planning, and patient education (Crevenna, 2016). Gutenbrunner et al. (2011) describe the most relevant parts of rehabilitation medicine:

- medical interventions (improvement of functions or body structures, e.g. pain therapy)
- physical therapies and physiotherapy (e.g. electrotherapy, balneotherapy, massage therapy)
- occupational therapy (e.g. training of activities of daily living and occupation)

A further relevant topic in orthopedic rehabilitation is pain and its treatment, as it is one of the most common concomitant phenomena after surgeries like for amputation and total arthroplasties. Pincus et al. (2013) consider the concept of a multifactorial approach to be the dominant model. It enables an explanation for a discrepancy between objective disability and subjective impairment, which is being observed in chronic pain patients. The multifactorial cause model of pain consists of somatic, psychosocial and psychological (psychosomatic) causes (Michalski et al., 2009):

- Somatic causes: e.g. dysfunctions of joints, dysfunctions of muscles, degenerative changes; insertions, joints, ligament approaches; bacterial infections, rheumatic diseases; trauma, metabolism, tumor, structural defects
- Psychosocial aspects: e.g. problems in daily life, work situation, desire for entering retirement
- Psychological aspects: e.g. anxiety, depression, low self-esteem
For pain rehabilitation, posture training, early mobilization, muscle stretching, manual therapy and back exercises are common physical therapy modules. For chronic pain, psychosocial interventions such as change of workplace or pain/stress management can also be helpful (Hoffman et al., 2007). Behavioral and psychotherapeutic intervention enable change of the emotional impairment, and can help to overcome false or avoidant posture and physical deconditioning.

For a well-working rehabilitation process, interdisciplinary team work is key. A good coordination of measurements and procedures has been shown to enhance the rehabilitation process outcome (Neumann et al., 2010). Eventually, the standard procedures for LLA and TAP have many common denominators, e.g. physical therapy, massage therapy, balneotherapy, electrotherapy, or walking analysis. These procedures were applied for the studies of this thesis and are described in the methods part in section 5.5.1.

3.1. Amputee Rehabilitation

In the United States, 80,000 lower limb amputations due to diabetes are performed every year (Margolis et al., 2011). The trend nowadays moves away from young trauma patients towards more than 80 % of patients with advanced generalized diseases such as PAOD with or without diabetes mellitus (Nuhr, 2017). Many patients have previously experienced multiple surgeries (e.g. vascular surgery) and show a variety of physical function deficits, such as degenerative changes in other joints, cardiovascular limitations, metabolic disorders, or eye diseases.

The amputation level in lower limbs is a decisive factor for rehabilitation. The energy expenditure of the transfemoral amputee is higher compared to a transtibial amputee (Ip, 2007). One of the reasons is that the knee flexion moment is countered by the quadriceps. If the amputation level is high above knee-level, this might mean a significantly increased energy expenditure during subsequent walking for the patient (Vogel et al., 2014). Especially the knee joint is of major importance for future rehabilitation prospects, since with an intact knee many problems related to an artificial knee joint can be avoided (Highsmith et al., 2010).

Once the postoperative phase (including e.g. wound healing, pain reduction, and mobilization and mental stability) has been overcome, one of the most important parts of rehabilitation is prosthesis fitting (Nuhr, 2017). In contrast to lower limb amputation, upper limb amputation patient’s mobility in general is less restricted, so that in an
experienced center with appropriate equipment (intensive occupational therapy, training, highly skilled prosthetics), an outpatient treatment can be sufficient.

To classify the abilities of an amputee properly, the functional K-Classification system has become a standard measurement tool. The five levels according to the Medicare Functional Classification Level MFCL (Gailey, 2002) are:

K0 = unable to ambulate or transfer safely with or without assistance, a prosthesis does not enhance quality of life or mobility

K1 = mainly household ambulator, may use a prosthesis for transfer or ambulation in level surfaces at a fixed cadence

K2 = limited community ambulator, may be capable of using the prosthesis to negotiate low-level environmental barriers, e.g. curb, stairs and uneven surfaces

K3 = community ambulator, with potential to achieve ambulation with variable cadence, negotiate most environmental barriers, may achieve prosthetic use beyond simple locomotion

K4 = typical of prosthetic demands of the child, athlete, or very active adult. Having the potential to exceed basic ambulation skills, and participate in activities of high impact, stress and energy levels

Unlike to other patient groups during rehabilitation, amputees have to deal with different types of pain: not only lower back pain is a common phenomenon (Ephraim, 2005), but also stump pain and phantom limb pain (Schley et al., 2008). In general, the intensity of PLP decreases after a few months, however, PLP keeps existing in a vast percentage (55 – 76 %) of amputees (Ephraim et al., 2005). Although there are many therapy methods being established for pain treatment (e.g. mirror therapy, relaxation therapy), no outstanding and helpful therapy has been identified so far.

3.2. Total Arthroplasty Rehabilitation

Rehabilitation plays an important role in the overall outcome of any joint replacement surgery. The goals are to prevent contractures, strengthen muscles around the hip joint through controlled exercises, and improve patient education. Contractures do not allow for the full range of motion and therefore impede mobility of the replaced joint.
Total knee and hip arthroplasty have become standard procedures in orthopedic surgery. The incidence of total knee arthroplasties in western countries is 150 – 200/100,000 inhabitants (Den Hertog et al., 2012). Typically, rehabilitation services are offered for inpatients after surgery, leading later to follow-up treatment in special orthopedic rehabilitation centers. Length of stay varies from country to country; a minimum length of stay in Germany, for example, can be 6 days (Den Hertog et al., 2012). In Denmark, for instance, a fast-track rehabilitation has become a common standard. Different to amputee rehabilitation, where inpatient rehabilitation is indispensable, total arthroplasty patients often have the option to choose between inpatient and outpatient rehabilitation. Buhagiar et al. (2017) compared inpatient rehabilitation for total knee arthroplasty patients with two home-based rehabilitation programs and found no differences regarding 6MWT or HRQOL. However, an intensive aftercare is not to be neglected (Stein & Greitemann, 2015).

Arthroplasty surgery is done to relieve pain sensations but also to enhance movement abilities by reconstructing or aligning a joint. In Germany, there are about 350,000 hip and knee replacements carried out every year (Schäfer et al., 2013). The majority of patients undergoing total knee and hip arthroplasty are elderly people in the 65 to 74 years age group (Westby, 2012). Osteoarthritis is the primary cause for arthroplasty, with regard to hip it is 81 %, and knee 94 % (Westby, 2012). Higher obesity and inactivity rates lead to the assumption that total joint arthroplasties will keep increasing (Westby, 2012).

Postoperatively, mobilization, gait, exercise, and balance training are named the most important factors for a proper recovery (Westby, 2012). Standard physical therapies contain e.g. walking analysis and training, massage therapy, balneotherapy, electrotherapy, and thermotherapy (Stein & Greitemann, 2015).

Although there is a high number of patients reporting no further impairment after surgery, up to 25 % report postoperative pain, functional problems, and limitations in activity even two years after surgery (Westby, 2012). In a study of Brander et al. (2003), postoperative pain could be linked to higher levels of depression and anxiety. Environmental factors such as social support and socioeconomic status can have an influence on the postoperative status: Lopez-Olivo et al. (2011) found in a prospective study that lower education and lower social support were associated with higher pain and decreased functional outcomes 6 months after surgery.
4. Mental Health in Orthopedic Rehabilitation

To get a deeper insight into the needs and tasks of psychology in the rehabilitative field, rehabilitation psychology, relevant psychological disorders, health-related quality of life, psychosocial variables and treatment standards are being explained.

4.1. Rehabilitation Psychology

Since the field of rehabilitation psychology started emerging over the past four decades, it is a relatively new field within psychology. It has developed due to an increasing demand for a holistic approach in rehabilitation. Rehabilitation psychology has become well-established in a broad range of different rehabilitation fields, such as cardiac rehabilitation or neurological rehabilitation (Bengel & Mittag, 2015). However, there is still a lack of knowledge when it comes to research in these settings since the number of psychologists as well as the time available are often limited in rehabilitation centers.

The subject of rehabilitation psychology is the measurement and reintegration of patients regarding personal and social problems, psychological issues, disabilities and chronic diseases. It furthermore deals with questions of health promotion and prevention. Rehabilitation psychology in its requirements is different from the traditional psychotherapy setting, since rehabilitation requires interdisciplinary expertise. Furthermore, rehabilitation psychologists require a different background knowledge and different skills: not only should they have an expertise in psychological diagnostics, counselling and psychotherapy, but also health prevention and promotion, patient education, and basic medical knowledge, since physical conditions of the patients play an important role in the rehabilitation setting. Other important topics for psychological treatment are self-management, empowerment, resource building, relaxation techniques, work re-integration, and integration of relatives (Bengel et al., 2013). As a matter of fact, psychological disorders in patients with chronic diseases are continuously increasing (Bengel & Mittag, 2016). Around 20 – 40 % of patients in a rehabilitation setting are diagnosed with a psychological comorbidity (Bengel et al., 2013).

4.2. Relevant Psychological Disorders

A third of the admitted patients in an inpatient rehabilitation setting are in need of psychological treatment (Bengel et al., 2013). In the orthopedic rehabilitative setting, psychologists are confronted with several psychological disorders, either arising from the
patients’ physical disease and pain, or disorders which already existed before. The most common and relevant disorders according to ICD-10 are being explained.

**Body-image disorders (F45.22)**

Body dysmorphic disorder (also termed body dysmorphia or dysmorphic syndrome) describes a body identity disorder where people feel a strong desire to adapt their physical appearance to the physical body image, according to ICD-10 classification of mental and behavioral disorders (Dilling & Freyberger, 2011). As long as a certain adjustment is not carried out, people react with uncertainty, depression and also suicide attempts. Generally starting during adolescence, it is a common mental disorder, and affects men and women quite equally, with a 2 % prevalence in general population (Veale et al., 2014). Being afraid of being thought vain, persons with body dysmorphic disorder tend to keep their preoccupation secret, therefore body dysmorphic disorder is underdiagnosed. Being an impairment affecting quality of life, body dysmorphic disorder can lead to social isolation and involves especially high rates of suicidal ideation (Veale et al., 2014). The body dysmorphic disorder subtype muscle dysmorphia, nearly exclusive to males, involves preoccupation with the body or some part of it being too small.

**Affective disorders (F30 – 39)**

Affective or mood disorders are defined as a “fundamental change in affect or mood to depression or to elation” (Dilling & Freyberger, 2011). Affective disorders include manic episodes, bipolar affective disorders, depressive episodes, recurrent depressive disorders, persistent mood disorders, other mood disorders and unspecified mood disorders. Depressive disorders are often being observed in orthopedic rehabilitation patients (Rutledge et al., 2013). Depressive patients show symptoms such as lowered mood, reduction of energy and decrease in activities. Depending on the severity and the number of symptoms, depression is classified into mild, moderate or severe episodes. In the rehabilitation setting, the depressive level of patients is often not considered clinically relevant or not sufficiently assessed, although it can have a major influence on the course of rehabilitation.

**Anxiety Disorders (F40 - F41)**

The most common symptoms of anxiety disorders are feelings of anxiety and fear. Anxiety is defined as a worry about future events and fear in reaction to current events.
Feelings such as fear can also cause physical symptoms. Anxiety disorders cluster different types of anxiety phenomena, such as phobias, panic disorders, generalized anxiety disorder, or social anxiety disorder. Anxiety disorders can have its cause in genetics but also may be due to drug use or resulting from the attempt to withdrawal from a drug. Anxiety often appears in high comorbidity with other mental disorders, in particular depressive or bipolar disorders, personality disorders and eating disorders. The term anxiety covers four different aspects of experiences: mental apprehension, physical tension, physical symptoms and dissociative anxiety. Treatment options of anxiety can include behavioral therapy, medication or lifestyle changes (Cuijpers et al., 2014). Medications are typically recommended only if other treatment methods are not proven to be effective. Anxiety disorders usually occur more often in females than males (2:1 ratio).

**Substance dependence (F10 – F19)**

According to ICD-10 (Dilling & Freyberger, 2011), a differentiation between substance intoxication, substance abuse, substance dependence and further disorders is made. Substance abuse is defined as the misuse of psychotropic substances which can result in health damage. This damage may be of physical or mental nature, such as hepatitis infection caused by the use of contaminated needles or depression secondary to alcohol abuse. Dependence is classified as the harmful use and the concept of abuse of psychotropic substances (Dilling & Freyberger, 2011). Substance dependence can be linked either to a substance, a substance group or a wide spectrum of substances. It can be differentiated by the appearance or non-appearance of physical symptoms. For the classification, the current abstinence and various remission stages such as participation in a supervised substitute program are being taken into account. This helps to differentiate the course of dependence in a more precise way.

**Somatoform disorders (F45)**

The most relevant somatoform disorders encountered in orthopedic rehabilitation are fibromyalgia and somatic symptom disorders.

*Fibromyalgia*: Fibromyalgia is a disorder which is characterized by chronic pain perceived in the whole body and a painful response to pressure stimuli. Other symptoms can be for example fatigue, which is influencing the ability to perform normal activities. Also sleep disturbance and joint stiffness are common symptoms. Fibromyalgia is associated with psychiatric disorders such as depression and anxiety, also with stress-
related disorders such as posttraumatic stress disorder. Not all patients with fibromyalgia experience all the above mentioned symptoms. The etiology of fibromyalgia is still unknown but is has been found to involve psychological, genetic, neurobiological and environmental factors (Tedder et al., 2015). The central symptom of fibromyalgia, widespread pain, seems to result from neuro-chemical imbalances.

**Somatic symptom disorder**: Somatic symptom disorder, formerly known as somatoform disorder, is subjectively experienced as impairing physical complaints for which no other proper explanation can be found within the course of the medical diagnosis process (Lahmann et al., 2010). This means that there is no organic cause found or the degree of symptoms is below the expected organic finding (Martin & Rief, 2006). Individual somatoform complaints are widespread and include mostly temporary headache, dizziness, increased palpitations, increased blood pressure, or sweating. Among the most common complaints is general pain, about which up to 70 % of the general population complain (Lahmann et al., 2010). The symptoms of patients with somatoform disorders are heterogeneous, ranging from neurological dysfunction over localized or generalized pain, organ dysfunction and vital disturbances and fatigue, to body-related fears and illness beliefs. Typical behaviors include physical avoiding behavior, misuse of medication and the increased use of medical services such as a frequent change of medical doctors (Martin & Rief, 2006).

**Dementia (F00 – F09)**

Diseases like Alzheimer’s disease or vascular dementia need to be mentioned in this context as well, since the majority of amputees but also other orthopedic patients are of older age. According to ICD-10, dementia covers a broad range of brain diseases that cause a decrease in the ability to think and remember. Usually, a person's daily functioning is also affected. Other common symptoms can include emotional problems, problems with language, and a decrease in motivation. For a proper diagnosis, a change from a person's usual mental functioning and a greater decline than one would expect due to normal aging, must be visible. A common type of dementia is Alzheimer’s disease which makes up between 50 % and 70 % of the cases (Reitz & Mayeux, 2014). Other common types are vascular dementia (25 %) and Lewy body dementia (15 %). Diagnosis is usually based on history of the illness and cognitive testing with medical imaging used to exclude other possible causes. The mini mental state examination is one commonly used cognitive test. Efforts to prevent dementia include trying to decrease risk factors such as high blood pressure, smoking, diabetes and obesity.
4.3. Health-Related Quality of Life (HRQOL)

Health-related quality of life is one part of the general umbrella term quality of life (QOL). The difference between QOL and HRQOL is that QOL focuses on different aspects of life such as economic or living aspects, whereas HRQOL specifically focuses on the physical and mental health of an individual. However, both concepts are multidimensional. The most essential aspects apart from physical and mental health are social functioning, role functioning and general well-being. In general health care, the overall goal is to maximize the HRQOL as well as possible. Over the past decades, it has become an accepted fact that HRQOL is the most important variable to assess regarding the outcome and effectiveness of a specialized inpatient treatment institution. Orthopedic patients after critical illness are at risk of permanent health deficits. This may affect mental health and social functioning which reduces overall HRQOL significantly. Moreover, a significant growth of research interest in HRQOL could be observed in the past two decades (Krops et al., 2017).

Literature offers some studies about HRQOL during cardiac rehabilitation (Janssen et al., 2013; Yohannes et al., 2010), also trauma rehabilitation has some interesting outcomes in research: Tøien et al. (2011), for instance, showed that trauma patients could increase their HRQOL after 3 to 12 months, however, their quality of life was significantly lower than in the general population. Yet, there is only little research available regarding amputees and their psychological correlates after amputation. Zidarov et al. (2009) showed that QOL after lower limb amputation (LLA) during rehabilitation remained quite high, also 3 months after successful rehabilitation. The mentioned studies show that a high HRQOL might have an influence on the rehabilitation process of amputees, but also that goal-oriented and well-structured rehabilitation programs might increase the HRQOL of patients (Spruit et al., 2004). However, not only for amputees but also for other patient groups in orthopedic rehabilitation such as patients after knee or hip surgery, HRQOL during rehabilitation plays an important role and might have an influence on general well-being (Ethgen et al., 2004; Bruyère et al., 2012).

4.4. Psychosocial Variables

The term “psychosocial” derives from psychological and social factors. Psychological factors include processes on the individual level and factors that influence mental state. The term “psychosocial” can therefore be seen as a combination of psychological and
social, but also implies the effect of social processes which sometimes are being mediated through psychological understanding (Rasul et al., 2007). Regarding psychosocial variables, the biopsychosocial model might also explain the causal relationship between onset and risk of a psychological disorder. The biopsychosocial model is a general approach which states that biological, psychological and social (socio-economical, socio-environmental, and cultural) factors play a significant role in human functioning in the context of disease or illness (Fava & Sonino, 2008). According to this model, health is therefore understood in terms of a combination of biological, psychological, and social factors rather than purely in biological terms. The concept is used in fields such as medicine, nursing, psychiatry, licensed professional clinical counselling, family therapy, social work, clinical psychology, and health psychology.

During inpatient rehabilitation, psychosocial variables can play an important role for the rehabilitation process and especially afterwards, psychosocial variables can be decisive concerning daily life routines. The most relevant variables regarding orthopedic rehabilitation are work, social support, lifestyle and socioeconomic status.

**Work:** Due to age distribution, many patients are already in retirement. However, there is a relevant percentage of younger people, for whom it is of high importance to be reintegrated into their working lives. A lot of accidents or development of disorders actually happen during work or due to work. Therefore, it is important that patients also learn to readapt to working life.

**Social networks/support:** Social networks in general can include relatives, peers, and colleagues. Social support has been shown to be an important mediator of health and rehabilitation in various studies (Staniute et al., 2013).

**Lifestyle:** Lifestyle is defined by variables like sports and nutrition. A healthy lifestyle is supposed to have a positive influence on the health status, mainly in the field of prevention of diseases (Chomistek et al., 2015).

**Socioeconomic status:** The APA defines socioeconomic status as “the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation.” Examinations of socioeconomic status often reveal inequalities when accessing resources, these include issues related to privilege and control.
4.5. Treatment Standards

In orthopedic rehabilitation, psychologists work according to standards in rehabilitation psychology (as described in chapter 4.1.). The treatment approaches may differ, depending on the target group. In orthopedic rehabilitation, psychologists work mainly in the field of medical rehabilitation, diagnostics, counselling, such as therapeutic and psychoeducational activities. Aspects of organizational and occupational psychology and research activities can complement this work field. A high number of rehabilitation facilities currently employ psychologists with an increasing trend. This development corresponds to the transformation of the understanding of disease from a unilateral somatic towards a multifactorial concept of illness. Also, the change of spectrum regarding disorders in the behavior-related and psychosomatic field such as job-related stress has increased considerably. In physical rehabilitation all forms of physical diseases, such as orthopedic, cardiovascular, rheumatologic, neoplastic, metabolic and respiratory diseases, are being treated. These chronic conditions often show interaction of a physical and mental development, usually as a result of negative psychological and social consequences in the course of the disease. Therefore, in addition to the somatic-medical treatment, psychological counselling and therapy is required as part of the framework of medical rehabilitation. According to medical rehabilitation, the following psychology-related goals are to be achieved (Bengel & Mittag, 2016):

- Completion of rehabilitation-related diagnostics
- Creation of a rehabilitation plan (in terms of psychological aspects)
- Helpful individual information and advice for patients and their families
- Optimization of the medical treatment and the performance of physical, psychological and other treatment measures
- Promoting a reasonable adjustment to disease and a motivational aspect to deal with the disorder
- Behavior modification with the aim of forming an adequate understanding of disease
- Nutrition, exercise and leisure (lifestyle component)
- Socio-medical assessments of the performance in need of rehabilitation
- Planning of further activities after the rehabilitation stay

Psychology in orthopedic rehabilitation includes several treatment aspects which are further explained below:
Psychoeducation

Psychoeducation is defined as the education which is offered to the patients and also to their families to inform them, to empower them to deal with their condition in an optimal way, and to discuss and exchange experiences on a regular basis (Von Wachter & Hendrischke, 2015). Psychoeducational training can be provided regarding psychological disorders like depression or substance dependence but also to related topics which can be the cause for psychological disorders, e.g. pain. In the orthopedic rehabilitation setting, it is important to provide the patient with sufficient knowledge about the disease and its possible correlation to psychological consequences or disorders. Another important part is information management concerning institutions or professionals patients can turn to once they are discharged from the rehabilitation center. If the professional has the impression that the patient needs further treatment or cannot provide the patient with adequate treatment, the psychologist should equip the patient with sufficient information about further treatment options and possibilities.

In the Austrian rehabilitation center where the data collection for this study took place, psychoeducational training has become a standard procedure for all arriving orthopedic patients, in addition to other educational training regarding physical, physiotherapeutic or nutritional content. Patients are being offered the participation in specific psychoeducational trainings about smoking and phantom limb pain in small groups.

Counselling and Psychotherapy

According to the APA (American Psychological Association), psychotherapy is a “collaborative treatment based on the relationship between an individual and a psychologist. Grounded in dialogue, it provides a supportive environment that allows to talk openly with someone who is objective, neutral and nonjudgmental”. Psychotherapy can be offered only to a certain extent since the patient’s rehabilitation stay is often too short for an adequate treatment. Furthermore, patients have a tight time schedule with focus on physical rehabilitation. Therefore, it is important that the psychologist also informs the patient about possible treatment options after the rehabilitation stay.
Relaxation Techniques

Relaxation techniques have been found to be helpful after physical incision and can be an important part of psychological intervention contributing to patient’s health (Delui et al., 2013; Vancampfort et al., 2013). Physical and psychological stress can lead to stress related disorders, this is because a certain kind of stress can have damaging effects on the patient’s health. Relaxation techniques can be helpful tools for coping with stress and might promote long-term health by calming down the body and also relaxing the mind. Relaxation techniques focus on attention, increase body awareness, and include exercises such as meditation. If exercised frequently, these practices can lead to a healthier perspective on mental and physical health. Different types of relaxation techniques in the orthopedic rehabilitation setting are being used (Bengel & Mittag, 2016):

- Breathing techniques: different techniques are being taught, so the patient is able to reach a psychophysical level of relaxation. It is often being used in combination with biofeedback, which is explained in detail below.
- Progressive muscle relaxation (PMR): This technique requires to tense and then relax each muscle group individually, normally starting with the extremities.
- Autogenic training: This technique uses visual imagery and body awareness to get the patient into a deep state of relaxation. The patient, for example, learns to imagine a peaceful place and then focuses on different physical sensations.
- Guided imagery: Similar to autogenic training, imagery involves listening to a trained therapist (or also recorded guided imagery) to be able to get into a state of deep relaxation. Once the patient is in a relaxed state, the images that appear can help to uncover important realizations about the mental, emotional and physical health state.

Clinical studies show that relaxation techniques reduce the perception of pain (Lauche et al., 2013). Relaxation techniques are regarded as a complement to usual psycho-rehabilitative care and should therefore be embedded in the usual medical and psychological treatment standards.
Biofeedback

For psychological treatment during orthopedic rehabilitation, biofeedback has been found to be a helpful treatment tool. Applied biofeedback (Schwartz & Andrasik, 2003) is defined as a therapeutic procedure that uses electronic devices to accurately measure, process and feed back to patients and therapists information with educational and reinforcing properties about their neuromuscular and autonomic activity. Biofeedback has become a well-known method working mainly with psychological disorders like anxiety disorders (Reiner, 2008), depression (Karavidas et al., 2007), attention deficit disorder (Monastra et al., 2005), substance abuse (Sokhadze et al., 2008), as well as different psychosomatic symptoms. In pain research, biofeedback has been applied for tension headache, migraine, stress reduction, muscle pain, and also PLP. Flor (2002) trained amputees to find out location and frequency of shocks delivered to the stumps. This resulted in an expansion of corresponding cortical regions and significant reduction of their PLP. The setting of biofeedback is based on the biofeedback hardware device which is connected to a computer. Electrodes are fixed either at patient’s hand or other parts of the body (depending which parameters are measured). Via the computer screen, therapist and patient can see the visualized body parameters and interpret and work with them. Clinical symptoms and diagnoses indicating the use of biofeedback can be, for example, stress tolerance, anxiety, depression, relaxation exercises, pain and muscular tension.
II. EMPIRICAL PART

5. METHODS

5.1. Aims of the study

Previous studies showed a correlation of amputation and decreased mental health, including decreased HRQOL, increased depression and a decreased body image (Zidarov et al., 2009; Asano et al., 2008; Willrich et al., 2005). Different studies focusing on military population mentioned a correlation between poor mental health and amputation, especially during recovery process (Krueger et al., 2015; Ladlow et al., 2015; Mckechnie, 2014), but the outcomes in a non-military population are poorly researched. This dissertation aims at demonstrating the important effect of physical rehabilitation on mental health after amputation.

Other studies tried to show that HRQOL of amputees was supposed to improve in the course of the rehabilitation process (Stineman et al., 2005; Bechara et al., 2007). However, none of the provided analyses investigated long-term effects of the treatment. One previous study on amputees’ mental health (Zidarov, 2009) showed the endurance on a long-term basis, however, the population does not match with a standard population given to the fact that this study was being conducted in a military context. As shown by Duivenvoorden et al. (2013), non-amputees also suffer from different mental health issues like depression and anxiety, and struggle with impaired physical health and pain, especially before surgery. Therefore, a more detailed comparison of mental health issues in patients with no amputation during physical rehabilitation was taken into consideration.

The hypotheses in this thesis can be divided into two parts. The first part refers to the differences in lower limb amputees (LLA) and total arthroplasty patients (TAP) regarding mental health and HRQOL at admission and throughout the course of the rehabilitation stay (T1 to T2). The second part examines differences in transtibial (TTA) and transfemoral (TFA) amputees regarding mobility, ADL, prosthesis use, pain and HRQOL at admission, throughout the course of the stay, and possible correlations at discharge. The results should help to underline the relevance of mental health during physical rehabilitation and of a well-structured rehabilitation stay in general.
Table 1

Overview of amputee studies which analyze similar parameters (mobility, mental health, ADL, prosthesis use, HRQOL, depression, body image), and are comparable with regard to sample size and content to the measures of this thesis

<table>
<thead>
<tr>
<th>First author</th>
<th>Test</th>
<th>Year of Publication</th>
<th>Sample</th>
<th>Total sample size</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akarsu</td>
<td>SF-36, 6MWT, 10mWT, Houghton Scale, ABIS (Amputation Body Image)</td>
<td>2012</td>
<td>LLA</td>
<td>30</td>
<td>Sample size</td>
</tr>
<tr>
<td>Bhangu</td>
<td>Houghton Scale, 2 Minute Walk Test, Frenchay Daily Activities</td>
<td>2009</td>
<td>LLA</td>
<td>31</td>
<td>Retrospective research design</td>
</tr>
<tr>
<td>Coffey</td>
<td>WHODAS (Disability Assessment), WHOQOL-BREF</td>
<td>2014</td>
<td>LLA</td>
<td>64</td>
<td>No further psych. parameters</td>
</tr>
<tr>
<td>Hanley</td>
<td>NRS (for PLP)</td>
<td>2004</td>
<td>PLP patients</td>
<td>70</td>
<td>Only PLP measures</td>
</tr>
<tr>
<td>Rau</td>
<td>TUG, 2 minute walk test</td>
<td>2007</td>
<td>LLA</td>
<td>58</td>
<td>exclusively male population</td>
</tr>
<tr>
<td>Willrich</td>
<td>Zung Depression Scale, SF-36</td>
<td>2005</td>
<td>Charcot foot, LLA</td>
<td>40</td>
<td>No physical parameters</td>
</tr>
<tr>
<td>Zidarov</td>
<td>ABIS, SF-36</td>
<td>2009</td>
<td>LLA</td>
<td>19</td>
<td>Sample size</td>
</tr>
</tbody>
</table>
5.2. Objectives and Research Hypotheses

The focus of this thesis was to evaluate amputees’ mental health condition after amputation during orthopedic inpatient rehabilitation regarding various aspects. The underlying assumption implies that mental health after amputation is impaired and can be improved throughout the course of physical rehabilitation. This thesis intended to show and compare the mental health status of lower limb amputees (LLA) compared to total arthroplasty patients (TAP) at admission and throughout the course of rehabilitation. Second, an analysis using the same sample with only amputated patients compared the possible differences between transtibial and transfemoral amputees regarding physical and mental parameters (mobility, ADL, prosthesis use, pain, HRQOL) throughout rehabilitation.

Part I:

Hypothesis 1 (H1): LLA show lower scores in mental health (MH) and health-related quality of life (HRQOL) compared to TAP at admission of rehabilitation.

Null Hypothesis (H0): LLA show same or comparable scores in MH and HRQOL compared to TAP at admission of rehabilitation.

Hypothesis 2 (H2): LLA and TAP show significantly increased MH and HRQOL scores from T1 (admission) to T2 (discharge).

Null Hypothesis (H0): LLA and TAP show no significant increase in MH and HRQOL scores from T1 to T2.

Hypothesis 3 (H3): LLA show significantly higher MH and HRQOL scores from T1 to T2 compared to TAP.

Null Hypothesis (H0): Both groups show the same significant improvement in MH and HRQOL scores comparing T1 and T2.
Part II:

Hypothesis 5 (H5): TTA show higher mobility and ADL, but same prosthesis use, pain sensation and HRQOL at admission of rehabilitation than TFA.

Null Hypothesis (H0): TTA show comparable mobility, ADL, but different prosthesis use, pain sensation and HRQOL at admission of rehabilitation to TFA.

Hypothesis 6 (H6): TTA and TFA significantly improve mobility, ADL, prosthesis use, pain sensation and HRQOL from T1 to T2.

Null Hypothesis (H0): TTA and TFA cannot significantly improve mobility, ADL, prosthesis use, pain sensation and HRQOL from T1 to T2.

Hypothesis 7 (H7): TTA differ significantly regarding mobility, ADL, prosthesis use, pain sensation and HRQOL during the course of inpatient orthopedic rehabilitation from TFA.

Null Hypothesis (H0): TTA do not differ significantly regarding mobility, prosthesis use, ADL performance and pain during the course of rehabilitation from TFA.

Hypothesis 8 (H8): Higher prosthesis use and ADL at discharge is correlated positively with higher mobility in both groups.

Null Hypothesis (H0): Higher prosthesis use and ADL at discharge are not significantly correlated with higher mobility.

5.3. Study Design and Procedure

To investigate the objectives and hypotheses, the consecutive cases study was conducted in a time period from January 2014 to January 2015. The Orthopedic Rehabilitation Center Zicksee has a strong focus on treating amputees in an inpatient and outpatient setting. In a pre-selection procedure, patients at admission were asked if they wanted to participate in the study. Out of these patients, study participants were recruited in a consecutive case series. Of the 104 questionnaires, 101 were successfully
completed, as 3 LLA could not complete their stay due to illness. This implies a response rate of 97.1%. The control group was included non-amputated patients, who afterwards were grouped into a total arthroplasty patient group (TAP). Therefore, 4 patients with surgeries other than knee and hip arthroplasty were excluded of the data analysis, in order to have a homogenous control sample. Finally, data of 97 patients was analyzed. The questionnaires on sociodemographic data, mental health (FKKS, BDI-II) and HRQOL (SF-36) were performed by the study coordinator with patients using the computer at the Clinical and Health Psychology Department of the rehabilitation center. The questionnaires were completed at admission and discharge. The analysis of the results was carried out with a computer. The walk tests and clinical standardized measures (6MWT, TUG, 10mWT, EQ-5D, Barthel Index, Houghton Scale, pain) were carried out by the responsible clinical staff. The patient groups were compared with regard to mental health, health-related quality of life and physical health.

5.4. Participants and Recruitment

Subjects were admitted to the Orthopedic Rehabilitation Center Zicksee, Austria, which is specialized in amputee rehabilitation. Exclusion criteria were (1) not being fluent in German, (2) cognitive impairment, (3) upper extremity amputations. Of the 104 tested patients three had to be excluded from analysis because of unexpected illness during the rehabilitation stay which discontinued their stay. In total, 50 amputees participated. 33 of them were transtibial amputees, and 17 of them transfemoral amputees. For the non-amputated group, 51 patients (surgeries in knee, hip or spine) were recruited, from which 4 patients with spine surgery were excluded to create a more homogenous sample. The sample was then consisting of 47 total knee and hip arthroplasty patients (TAP).

Ethics

This study was approved by the Ethics Committee. The study was performed according to the Declaration of Helsinki. All patients who were included received written and oral patient information and gave their written consent.
5.5. Study Material

According to orthopedic rehabilitation standards (explained in section 3), the physical rehabilitation program of LLA and TAP contained several components which are shortly being explained in section 5.5.1.

Patients were assessed at admission (T1) and at discharge (T2) of their rehabilitation stay which lasted between three and six weeks. The assessments consisted of different measurements and questionnaires which are being explained in section 5.5.2.

5.5.1. Rehabilitation Methods

Physiotherapy

The objective of physiotherapy is the preservation or restoration of these movement programs. The elaboration of a new movement program (e.g. maintaining an upright posture while standing, sitting and walking) requires a high number of repetitions until the movement becomes unconscious and automatic. In practice, physiotherapy usually combines different methods simultaneously. Common methods of physiotherapy are: passive measures, active movement therapy, physiotherapy on neurophysiological basis, physiotherapy with equipment, respiratory therapy, and relaxation therapy (Böhle et al., 2015).

Occupational therapy

In occupational therapy, “purposeful and meaningful activities are used in to restore people’s functioning and to prevent disability. Environmental barriers frequently need to be removed to facilitate people’s participation in social life” (Söderback, 2008). The primary goal of occupational therapy is to enable patients to participate in the activities of daily life. The main goals are to enable and increase the patients’ status of independence regarding activities of daily living, enhancement of mobility, and training of old and new routines.

Walking analysis

A detailed walking analysis is an important tool for the pre-post measurement after limb loss (Lamoth et al., 2009). The gait of humans is the result of the interaction between different mobile and immovable body segments. In analysis, the visual recording provides a first impression and enables an evaluation. Possible causes of changes in
movement or compensation mechanisms can be due to the surface being walked on. Data can be collected by doing a walking analysis via an electronic data acquisition, so data can be recorded and computerized. The three-dimensional walking analysis provides a diagnostic method for clinical information (Adachi et al., 2012).

**Balneotherapy and Hydrotherapy**

The concept of hydro- and balneotherapy uses water for different therapeutic purposes as part of physical therapy (Bender et al., 2004). Hydrotherapy encompasses the wide range of various water therapies, while balneotherapy primarily is used with therapeutically natural medicinal waters of any kind. Depending on the dominant type of stimulus, physical properties of water such as thermal conductivity, hydrostatic pressure, or frictional resistance come into action. The good thermal conductivity of water makes it easier for particular therapeutic orientation, and the heat from the skin surface dissipates so the body temperature is influenced to increase or to decrease (Bender et al., 2005). With an increase of difference between skin and water temperature, there are adequate changes on the skin’s blood circulation and appropriate reactions of thermal receptors.

**Massage**

Massage can be viewed as a holistic form of therapy. Although massage techniques differ, they have a similar effect: In the area of skin and muscles, there is a local hyperemia due to increased number of capillaries, capillary dilatation and increased permeability. Massage therapy can elicit physiological changes, including lower blood pressure and heart rate, decreased oxygen consumption and muscle tension, and lower levels of cortisol and noradrenaline (Adams et al., 2010). Furthermore, massage can reduce the area of muscle tension and has been shown to decrease postoperative pain (Cutshall et al., 2009). The improvement of tone and tropism results in pain relief. In the area of veins and lymph vessels, massage works by promoting a backflow. Depending on the technique applied, stimulating and relaxing effects in the central nervous system can be achieved.

**Electrotherapy**

Electrotherapy can be divided into different types, such as transcutaneous electrical nerve stimulation, pulsed-dose electrical stimulation applied by stocking electrodes, pulsed electro-magnetic fields, static magnetic field therapy, external muscle stimulation
and frequency-modulated electromagnetic neural stimulation (Pieber et al., 2010). The dose of the current, the size of the surface treatment and the type of treatment determine the duration. Another form of application of direct current are hydroelectric baths, such as a two-cell, four-cell or Stanger baths. By application of appropriate circuit electrodes, the current effect can be centered on a painful area. Contraindications for the use of electrotherapy are, for example, metal implants and pacemakers in the treatment area, lesions and skin infections, acute inflammation, thrombosis, risk of bleeding, and cardiac decompensation (Ip, 2007).

Patient Education

A standardized patient education assumes that doctors and therapists who moderate or coach the programs, are trained for it. Various professional associations, such as the German Society for Rheumatology, offer train-the-trainer seminars. These seminars both cover the content of training and introduce methodology. Participants develop awareness for communication and group dynamic processes. According to current understanding, patient education can provide important therapeutic targets, such as the avoidance of sequelae. The effectiveness of such training or training programs is proven by plenty of prospective and randomized controlled studies. There is striking evidence in the field of patient education described in individual studies (May et al., 2006), meta-analyses (Ellis et al., 2004) and even a systematic review of the Cochrane Collaboration on 25 randomized control group studies (Gibson et al., 2002). The studies showed that through patient education in adult asthmatics, the results of medical therapy statistically and clinically could be improved significantly.

Further rehabilitative components

There are different other rehabilitation components which are provided by other members of the multidisciplinary team such as nutritionists, nursing, wound management, orthopedic technicians, social workers. These are not explained in further detail. Nevertheless, all of them play an important role for orthopedic rehabilitation.

5.5.2. Tests and Questionnaires

5.5.2.1. Mental Health

FKKS

The Frankfurt Body Image Questionnaire (FKKS) (Deusinger, 1998) was used to determine the perception of the patients’ own body image. The scales were originally
developed to determine the dimensions of a person's self-concept but were further developed into an independent measurement tool for a person's body concept. The computerized version of FKKS consists of 64 items which belong to different scales such as self-care of the body or self-acceptance of the body. The scales measure attitudes towards one's own body, which are understood to be part of the individual's personality. The questionnaire contains nine scales which were developed through factor analysis (reliability: \( r = .87 \) to \( r = .96 \)):

1. Scale on Health and Physical Well-being (SGBK)
2. Scale on Personal Hygiene and Outward Appearance, Consideration of Physical Efficiency (SPKF)
3. Scale on Physical Efficiency (SKEF)
4. Scale on Physical Contact (SKKO)
5. Scale on Sexuality (SSEX)
6. Scale on Physical Self-acceptance (SSAK)
7. Scale on Physical Acceptance by Others (SAKA)
8. Scale on Aspect of Physical Appearance (SASE)
9. Scale on Dissimilatory Physical Processes (SDIS)

Out of the 9 existing scales, the 6 most relevant scales were chosen for this thesis in order to achieve high reliability, and also with regard to available time. From a test-theoretical point of view there is no conflict in selecting among the different scales since each scale is being calculated on its own. The level of agreement to each statement is rated on a 6-point-scale, resulting in sum scores for each body concept. The higher the score, the better the body concept. All scales have norms, such as additional norms for a negative, a neutral and a positive body concept.

**BDI-II**

For further psychological measurement, the Beck Depression Inventory BDI-II (Hautzinger, 2009) was used. It is one of the most commonly used tools to measure depressive symptoms in clinical settings. Its reliability and validity was assessed in many study populations, including samples with physical disability (Mozumdar & Roy, 2010).
The BDI consists of 21 items, each item has four possible answers to choose from. The German version of the BDI-II was used for this thesis. Regarding the test scores, the following categories were used: 0-13 (minimal), 14 -19 (mild), 20-28 (moderate), and 29-63 (severe).

5.5.2.2. Health-related Quality of Life

**SF-36**

For measuring the health-related quality of life, the widely known SF-36 measurement tool was used. The computer version of SF-36 consists of eight separate subscales as well as two sum scores which add together physical health (PH) and mental health (MH). The subscales are: 1) physical functioning (PF), 2) role limitations due to physical health (RL), 3) bodily pain (BP), 4) general health perceptions (GH), 5) vitality (VI), 6) social functioning (SF), 7) role limitations due to emotional health (EH), and 8) general mental health (psychological distress/wellbeing) (PD).

For HRQOL, the computerized version of SF-36 (Morfeld et al., 2011) was used. The version of SF-36 consists of 36 questions with 8 different subscales of HRQOL. In addition to the different subscales, sum scores of physical and mental health are generated. Norm scores were taken from a German general-population-based survey (Zweynert et al., 2009). The German version of the SF-36 Health Survey was used to evaluate HRQOL. The questionnaire comprises physical and mental components of QOL and therefore reflects the definition of health by the World Health Organization (WHO) which explicitly includes social and mental aspects.

**EQ-5D**

The EQ-5D is a short questionnaire for evaluating HRQOL. It comprises 5 items covering 5 dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression). The items have three response options. The norms for a random general population sample have were generated in the United Kingdom. For this study, the German version of EQ-5D was used. In a Swedish population, the EQ-5D has been found to be reliable, valid and easy to complete (Burström et al., 2001).
5.5.2.3. Physical Health

For mobility measurement, three tests which are common in rehabilitation were used: the 6-Minute Walk Test (6MWT), the Ten Meter Walk Test (10mWT) and the Timed-Up-and-Go Test (TUG). Normative data for all three tests such as disease-related normative data is provided in literature. (Scivoletto et al., 2011; Knorr et al., 2010).

6MWD

The 6MWT is a commonly used tool for rehabilitation processes and it assesses the distance which is walked over a timed period of six minutes. The patient is allowed to use assistive devices such as crutches but they then should be consistently used from test to test. The primary measurement of the 6 Minute Walk distance test is the total distance walked (in meters). This test is a useful measure for functional capacity and is targeted at people with at least a moderate impairment. It is widely used for measuring therapeutic interventions. Healthy subjects reach a distance between 400 and 700 meters depending on their age.

Timed „Up-and-Go“Test

The TUG assesses mobility, balance walking ability, and fall risk. At the beginning of the test, the patient sits on a chair with his back against the back. On the command “go”, he rises and walks three meters at a normal pace. Then he turns, walks back to the chair and sits down. Again, assistive devices are allowed if necessary. The result is being measured in seconds. The TUG is suitable to be used in rehabilitative settings and has been shown to be valid and reliable, especially in an elderly population (Brucki, 2015).

10 Meter Walk Test

The 10mWT assesses the walking speed during ten meters of walking distance. Assistive devices are also allowed in this test applying to the same conditions as in the 6MWT. It can be used to determine functional mobility, gait, and vestibular function. It is often used when assessing a lower limb amputee population.

Barthel Index

Activities of daily living were measured using the Barthel Index (BI) which assesses the abilities of a patient regarding self-care in daily routines. It assesses mainly patients with physical disorders, more specifically neurological or musculoskeletal disorders (Hsieh et
al., 2007). The total score ranges from 0 to 20. The Barthel Index contains several items for ADL: e.g. feeding, grooming, dressing, bowel care, bladder care, toilet use, ambulation, transfers, stair climbing. The total score ranges from 0 to 20.

**Houghton Scale**

It analyses the prosthetic use in lower limb amputees, discriminates between TTA and TFA, and reflects the amputee’s perception of prosthetic use (Devlin et al., 2004). The Houghton Scale is a 6-item measure of prosthetic use performance. The measure assesses the amount of time in which a prosthesis is used. It evaluates the manner in which it is used, whether a mobility device is used additionally when ambulating outside, and the perception of stability when walking over a variety of surfaces. The measurement provides a 4-point ordinal response option for the first 3 questions whereas the last 3 response options are binary (yes/no). The responses are summed up to provide a score ranging from 0 (poor performance) to 12 (maximum performance). Scores which are above 8 indicate a successful prosthetic ambulator. (Miller et al., 2001).

**Pain**

Phantom limb pain and its incidence, intensity and impairment were measured with numeric rating scales (NRS). General pain assessment was measured with VAS-Scales.

5.6. **Data analysis**

For the statistical analyses, descriptive statistics for socio-demographic data (gender, age, employment status, marital status) and clinical data (questionnaire scores) were described. Mean and standard deviation were used for the continuous data, and percentages were used for the categorical data. Independent t-tests were used to test the differences between means of groups. Paired t-tests were done to compare differences in groups at T1 and T2. The variances between the two measurement times (T1 and T2) were analyzed with one-way repeated measures ANOVA with time as within-subjects factor. As statistical program, IBM SPSS 22.0 for Windows was used. Statistical significance was defined with p < .05 level. All analyses were done with SPSS 22.0 for Windows. Results were significant at a p < .05 level.

Based on the number of patients which were selected for the study, it has a statistical power (1-β) of more than 80 % to detect an increase in mental health, HRQOL and physical health scores over 3–4 weeks in time with an α-level of 5 %. The power was primarily calculated for LLA and TAP.
6. RESULTS

6.1. Descriptive Data

The measurements and questionnaires of 97 orthopedic inpatient rehabilitation patients (mean age 62.3 ± 12.3) were included in this current study. For descriptive data of the amputee and non-amputee sample see table 2. The sample consisted of a total of 47 female and 50 male patients, 50 participants were amputees, and 47 participants total arthroplasty patients. The amputee group consisted of 66 % TTA and 34 % TFA, the most common amputation reason were vascular diseases (78.8 %). A secondary disease amputees frequently reported was hypertension (31 %). In the non-amputee group, the patient sample consisted of knee (51.1 %) and hip (48.9 %) arthroplasty patients. The two patient groups (LLA and TAP) showed comparable impairment in the psychosocial and pain domain, and given to this fact, their ability to work was limited. The mean time in terms of rehabilitation stay and time since amputation did not differ significantly according to the amputation level.

Regarding the characteristics of the amputee population, which were divided into TTA and TFA, TFA were older than TTA (see table 3). Timewise, duration of the rehabilitation stay was the same. The biggest difference at admission was in PLP, which was reported to be higher in TFA (75 %) than in TTA (30.3 %). Incidence, intensity and impairment were comparable in both groups.
Table 2

*Descriptive Statistics of Sociodemographic Data of Lower Limb Amputees (LLA) and Total Arthroplasty Patients (TAP) at Rehabilitation*

<table>
<thead>
<tr>
<th></th>
<th>Total (N = 97)</th>
<th>LLA (N = 50)</th>
<th>TAP (N = 47)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Women</strong></td>
<td>47</td>
<td>19 (38 %)</td>
<td>28 (59.6 %)</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td>50</td>
<td>31 (62 %)</td>
<td>19 (40.4 %)</td>
</tr>
<tr>
<td><strong>Age (mean, SD)</strong></td>
<td>62.3 ± 12.3</td>
<td>66.0 ± 11.7</td>
<td>58.4 ± 11.8</td>
</tr>
<tr>
<td><strong>Employment Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>61</td>
<td>39 (78 %)</td>
<td>22 (46.8 %)</td>
</tr>
<tr>
<td>Ill/ Unemployed</td>
<td>24</td>
<td>3 (6 %)</td>
<td>21 (44.7 %)</td>
</tr>
<tr>
<td>Working</td>
<td>12</td>
<td>8 (16 %)</td>
<td>4 (8.5 %)</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>52</td>
<td>23 (46 %)</td>
<td>29 (61.7 %)</td>
</tr>
<tr>
<td>Single</td>
<td>13</td>
<td>9 (18 %)</td>
<td>4 (8.5 %)</td>
</tr>
<tr>
<td>Divorced</td>
<td>16</td>
<td>9 (18 %)</td>
<td>7 (14.9 %)</td>
</tr>
<tr>
<td>Widowed</td>
<td>16</td>
<td>9 (18 %)</td>
<td>7 (14.9 %)</td>
</tr>
<tr>
<td><strong>Duration Stay</strong></td>
<td><strong>25 ± 5.1</strong></td>
<td><strong>21.8 ± 2.3</strong></td>
<td></td>
</tr>
</tbody>
</table>
Table 3

Descriptive Statistics of Sociodemographic Data of Transtibial Amputees and Transfemoral Amputees

<table>
<thead>
<tr>
<th></th>
<th>TTA (N = 33)</th>
<th>TFA (N = 17)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td><strong>Age (mean, SD)</strong></td>
<td>63.8 ± 13.1</td>
<td>70.4 ± 6.7</td>
</tr>
<tr>
<td><strong>Amputation Cause</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vascular (PAOD, DM, sepsis)</td>
<td>26</td>
<td>15</td>
</tr>
<tr>
<td>Non-Vascular</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td><strong>Phantom Limb Pain (Yes)</strong></td>
<td>10 (30.3 %)</td>
<td>12 (75.0 %)</td>
</tr>
</tbody>
</table>

6.2. **Hypotheses**

6.2.1. Part I: Changes in Mental Health and HRQOL during Physical Rehabilitation

Results at Admission (T1)

Contrary to the outlined hypothesis (H1), LLA showed no differences to TAP with regard to mental health parameters at admission. The t-test results of the mean values at admission of LLA and TAP showed no significant differences for all questionnaires (see table 4), except for the SF-36 sum score MH (p = .006) and the TUG (p = .015). LLA scored higher than TAP with regard to the MH parameters. TAP reported higher depression scores at admission, but not with a clinically relevant score. Regarding HRQOL, LLA showed higher scores on the MH sum scale of the SF-36 than TAP. TAP
reported higher depression scores at admission, however, not with a clinically significant score. The pain rating with the VAS scale was higher in TAP, and TAP also showed a better mobilization.

Table 4

Independent t-tests for Differences in Body Image, Depression, and HRQOL between Lower Limb Amputees (LLA) and Total Arthroplasty Patients (TAP) at Admission (T1) of Rehabilitation

<table>
<thead>
<tr>
<th>Scoring</th>
<th>LLA</th>
<th>TAP</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>FKKS SGBK</td>
<td>0 – 100</td>
<td>43.1 (26.6)</td>
<td>45.1 (25.9)</td>
</tr>
<tr>
<td>FKKS SPKF</td>
<td>0 – 100</td>
<td>63.7 (27.7)</td>
<td>69.8 (24.8)</td>
</tr>
<tr>
<td>FKKS SKEF</td>
<td>0 – 100</td>
<td>30.8 (20.3)</td>
<td>37.3 (22.0)</td>
</tr>
<tr>
<td>FKKS SKKO</td>
<td>0 – 100</td>
<td>45.4 (24.2)</td>
<td>58.3 (22.9)</td>
</tr>
<tr>
<td>FKKS SAKA</td>
<td>0 – 100</td>
<td>65.1 (24.9)</td>
<td>44.8 (24.7)</td>
</tr>
<tr>
<td>FKKS SASE</td>
<td>0 – 100</td>
<td>46.8 (20.2)</td>
<td>45.2 (25.4)</td>
</tr>
<tr>
<td>BDI-II</td>
<td>0 – 63</td>
<td>3.0 (3.1)</td>
<td>4.1 (4.9)</td>
</tr>
<tr>
<td>SF-36 PH Sum Score</td>
<td>0 – 100</td>
<td>23.3 (17.0)</td>
<td>21.8 (17.7)</td>
</tr>
<tr>
<td>SF-36 MH Sum Score</td>
<td>0 – 100</td>
<td>69.6 (17.1)</td>
<td>56.8 (25.6)</td>
</tr>
<tr>
<td>VAS Scale</td>
<td>0 – 10</td>
<td>3.8 (3.1)</td>
<td>4.6 (2.2)</td>
</tr>
<tr>
<td>TUG</td>
<td>Sec.</td>
<td>31.4 (24.0)</td>
<td>19.9 (21.0)</td>
</tr>
</tbody>
</table>

Abbreviations. SGBK: Scale on Health and Physical Well-being; SPKF: Scale on Personal Hygiene and Outward Appearance, Consideration of Physical Efficiency; SKEF: Scale on Physical Efficiency; SKKO: Scale on Physical Contact; SAKA: Scale on Physical Acceptance by Others; SASE: Scale on Aspects of Physical Appearance; PH: Physical Health; MH: Mental Health. Note. Controlled for sex and age.
Results from Admission to Discharge (T1 to T2)

LLA could significantly improve MH and HRQOL from T1 to T2 (H2), except for the scales of FKKS on Physical Contact (SKKO) and Physical Acceptance by Others (SAKA). Both groups showed significant improvement from T1 to T2. Depressive symptoms decreased significantly in both groups (p < .001). Both groups improved significantly regarding HRQOL, the only exception was the MH sum scale for LLA (p = .12) which kept high throughout the rehabilitation stay compared to TAP and to general population. TAP could improve their MH significantly (p = .013), LLA mainly improved regarding physical health. LLA and TAP could improve pain sensation significantly from T1 to T2, and also mobility improved, although only TAP could significantly improve their walking performance.

Both groups improved significantly regarding HRQOL (H3), the only exception was on MH sum scale for amputees (p = .065), which stayed high throughout the complete rehabilitation stay compared to TAP and general population. TAP could improve their mental health significantly (p < .01), whereas amputees improved mainly on physical scales.
Table 5

*Paired t-tests for Differences in Body Image, Depression, and HRQOL from Admission (T1) to Discharge (T2) in Lower Limb Amputees (LLA) and Total Arthroplasty Patients (TAP) during the Course of Rehabilitation*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LLA</td>
<td>Mean</td>
<td>Mean</td>
<td>p</td>
<td>TAP</td>
<td>Mean</td>
<td>Mean</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td>T2</td>
<td>T1</td>
<td>T2</td>
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<td>T2</td>
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<td>T2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FKKS SGBK</td>
<td>-3.76</td>
<td>42</td>
<td>54</td>
<td>.001**</td>
<td>-1.54</td>
<td>46</td>
<td>52</td>
<td>.13</td>
</tr>
<tr>
<td>FKKS SPKF</td>
<td>-2.24</td>
<td>65</td>
<td>71</td>
<td>.03*</td>
<td>-0.62</td>
<td>70</td>
<td>71</td>
<td>.54</td>
</tr>
<tr>
<td>FKKS SKEF</td>
<td>-2.68</td>
<td>30</td>
<td>38</td>
<td>.01*</td>
<td>-1.06</td>
<td>40</td>
<td>43</td>
<td>.30</td>
</tr>
<tr>
<td>FKKS SKKO</td>
<td>-1.73</td>
<td>46</td>
<td>52</td>
<td>.09</td>
<td>-2.0</td>
<td>53</td>
<td>58</td>
<td>.05*</td>
</tr>
<tr>
<td>FKKS SAKA</td>
<td>.19</td>
<td>66</td>
<td>65</td>
<td>.85</td>
<td>-1.95</td>
<td>60</td>
<td>67</td>
<td>.06</td>
</tr>
<tr>
<td>FKKS SASE</td>
<td>-2.39</td>
<td>47</td>
<td>55</td>
<td>.02*</td>
<td>-3.13</td>
<td>46</td>
<td>53</td>
<td>.004**</td>
</tr>
<tr>
<td>BDI-II</td>
<td>3.54</td>
<td>3</td>
<td>2</td>
<td>.001**</td>
<td>3.47</td>
<td>4</td>
<td>2</td>
<td>.001**</td>
</tr>
<tr>
<td>SF-36 PH</td>
<td>-6.68</td>
<td>23</td>
<td>40</td>
<td>.000**</td>
<td>-4.84</td>
<td>23</td>
<td>33</td>
<td>.000**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 MH</td>
<td>1.59</td>
<td>71</td>
<td>68</td>
<td>.12</td>
<td>-2.61</td>
<td>56</td>
<td>65</td>
<td>.013*</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS Scale</td>
<td>3.9</td>
<td>4</td>
<td>2</td>
<td>.000**</td>
<td>6.7</td>
<td>5</td>
<td>3</td>
<td>.000**</td>
</tr>
<tr>
<td>TUG</td>
<td>1.9</td>
<td>31</td>
<td>28</td>
<td>.07</td>
<td>2.5</td>
<td>20</td>
<td>16</td>
<td>.015*</td>
</tr>
</tbody>
</table>

*Abbreviations.* SGBK: Scale on Health and Physical Well-being; SPKF: Scale on Personal Hygiene and Outward Appearance, Consideration of Physical Efficiency; SKEF: Scale on Physical Efficiency; SKKO: Scale on Physical Contact; SAKA: Scale on Physical Acceptance by Others; SASE: Scale on Aspects of Physical Appearance; PH: Physical Health; MH: Mental Health
Table 6

One-Way Repeated Measures ANOVA to Analyze Differences in Body Image, Depression and HRQOL from T1 to T2 for Both Groups (LLA and TAP), with “Time” (T) as Main Factor and "Time x Group" (T x G) as Interaction

<table>
<thead>
<tr>
<th>Variables</th>
<th>T</th>
<th>T x G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Df</td>
<td>F</td>
</tr>
<tr>
<td>FKKS SGBK</td>
<td>1, 96</td>
<td>11.4</td>
</tr>
<tr>
<td>FKKS SPKF</td>
<td>1, 96</td>
<td>5.9</td>
</tr>
<tr>
<td>FKKS SKEF</td>
<td>1, 96</td>
<td>9.3</td>
</tr>
<tr>
<td>FKKS SKKO</td>
<td>1, 96</td>
<td>10.1</td>
</tr>
<tr>
<td>FKKS SAKA</td>
<td>1, 96</td>
<td>2.9</td>
</tr>
<tr>
<td>FKKS SASE</td>
<td>1, 96</td>
<td>1.5</td>
</tr>
<tr>
<td>BDI-II</td>
<td>1, 96</td>
<td>17.6</td>
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<td>SF-36 PH</td>
<td>1, 96</td>
<td>47.6</td>
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<tr>
<td>SF-36 MH</td>
<td>1, 96</td>
<td>4.6</td>
</tr>
<tr>
<td>VAS Scale</td>
<td>1, 96</td>
<td>45.8</td>
</tr>
<tr>
<td>TUG</td>
<td>1, 96</td>
<td>4.7</td>
</tr>
</tbody>
</table>

**Abbreviations.** SGBK: Scale on Health and Physical Well-being; SPKF: Scale on Personal Hygiene and Outward Appearance, Consideration of Physical Efficiency; SKEF: Scale on Physical Efficiency; SKKO: Scale on Physical Contact; SAKA: Scale on Physical Acceptance by Others; SASE: Scale on Aspects of Physical Appearance; PH: Physical Health; MH: Mental Health
In the ANOVA results, significant time effects could be proven for both groups in the FKKS scales, the BDI-II, the SF-36 sum scales, pain and mobility (see table 6), except for the body image scale on Physical Acceptance by Others. Interactions in Group (G) x Time (T) effects could not be observed, only for the SF-36 MH sum scale ($F (1, 96) = 8.4; p = .005$).

Figure 3

**Graphic Differences (T2 – T1) between Lower Limb Amputees (LLA) and Total Arthroplasty Patients (TAP) Regarding FKKS Scales, Including Standard Error**

Abbreviations. SGBK: Scale on Health and Physical Well-being; SPKF: Scale on Personal Hygiene and Outward Appearance, Consideration of Physical Efficiency; SKEF: Scale on Physical Efficiency; SKKO: Scale on Physical Contact; SAKA: Scale on Physical Acceptance by Others; SASE: Scale on Aspects of Physical Appearance; PH: Physical Health; MH: Mental Health
6.2.2. Part II: Differences in Transtibial Amputees Compared to Transfemoral Amputees

To examine differences between transtibial and transfemoral amputees over the course of their rehabilitation stay regarding mobility, ADL prosthesis use, pain and HRQOL, mean differences and variance analyses were conducted.

Results at Admission (T1)

TTA showed higher performance levels at admission of rehabilitation than TFA with regard to mobility (H5). Phantom limb pain (PLP) was more prevalent in TFA (75 %) than in TTA (30.3 %) at admission (table 3).

TTA started at a significantly higher performance level at admission than TFA in all three mobility tests (see table 7). In the 6MWT, TTA scored more than twice as high as TFA, and were more than two times faster in the TUG and in the 10mWT. Regarding ADL (Barthel Index), prosthesis use (Houghton Scale), pain (VAS), and HRQOL (EQ-5D), no significant differences between TTA and TFA were found at admission, although TTA reported higher ADL than TFA.
Table 7

Independent t-tests for Differences in Mobility, ADL, Prosthesis Use, and Pain between Transtibial Amputees (TTA) and Transfemoral Amputees (TFA) at Admission (T1) of Rehabilitation

<table>
<thead>
<tr>
<th>Variable</th>
<th>TTA</th>
<th>TFA</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scoring</td>
<td>Mean (+ SD)</td>
<td>Mean (+ SD)</td>
</tr>
<tr>
<td>6MWT</td>
<td>Mtrs</td>
<td>198.7 (90.3)</td>
<td>81.1 (56.0)</td>
</tr>
<tr>
<td>TUG</td>
<td>Sec.</td>
<td>29.4 (20.6)</td>
<td>57.5 (26.1)</td>
</tr>
<tr>
<td>10mWT</td>
<td>Sec.</td>
<td>27.8 (20.2)</td>
<td>64.9 (25.5)</td>
</tr>
<tr>
<td>Barthel Index</td>
<td>0 – 100</td>
<td>84.2 (11.4)</td>
<td>71.3 (26.1)</td>
</tr>
<tr>
<td>Houghton Score</td>
<td>0 – 12</td>
<td>4.5 (3.6)</td>
<td>4.6 (3.3)</td>
</tr>
<tr>
<td>Pain (VAS)</td>
<td>0 – 10</td>
<td>3.8 (3.0)</td>
<td>3.9 (3.2)</td>
</tr>
<tr>
<td>EQ-5D</td>
<td>0 – 100</td>
<td>69.0 (15.6)</td>
<td>61.8 (24.0)</td>
</tr>
</tbody>
</table>

Abbreviations. 6MWT: 6 Minute Walk Test; TUG: Timed Up and Go Test; 10mWT: 10 Meter Walk Test

Differences from Admission (T1) to Discharge (T2)

Overall, improvements from T1 to T2 could be observed, except for few tests (H6). TTA scored predominantly higher in all conditions (H7).

TTA could improve their walking performances from T1 to T2 in all three tests. TFA could improve their walking performance in the 6MWT and the 10mWT, only for the TUG, they could not significantly improve their performance (see table 8).

On the Barthel Index for ADL, both groups improved their performance significantly from T1 to T2 (p <.001), and did not differ significantly, although TTA started with a higher score than TFA. Regarding prosthesis use, both groups improved significantly (p <.001), and did not differ significantly. Pain sensation, measured with VAS scales, could only be
reduced significantly from T1 to T2 in TTA. Only TFA could significantly improve HRQOL from T1 to T2, although TTA reported higher scores and also improved. In sum, both groups improved in all tests (see table 9) from T1 to T2 (H6). There was no interaction between time T and group G.

Table 8

*Paired t-tests for Differences in Mobility, ADL, Prosthesis Use, and Pain from Admission (T1) to Discharge (T2) in Transtibial Amputees (TTA) and Transfemoral Amputees (TFA) during the Course of Rehabilitation*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>TTA</td>
<td>p</td>
<td>TTA</td>
<td>p</td>
<td>TFA</td>
<td>p</td>
<td>TFA</td>
<td>p</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>t (T2–T1)</td>
<td>Mean T1</td>
<td>Mean T2</td>
<td>t (T2–T1)</td>
<td>Mean T1</td>
<td>Mean T2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6MWT</td>
<td>-2.19</td>
<td>199</td>
<td>229</td>
<td>.036*</td>
<td>-2.66</td>
<td>81</td>
<td>113</td>
<td>.017*</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>TUG</td>
<td>4.10</td>
<td>29</td>
<td>20</td>
<td>.000**</td>
<td>0.07</td>
<td>57</td>
<td>57</td>
<td>.94</td>
<td></td>
<td></td>
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<tr>
<td>10mWT</td>
<td>2.31</td>
<td>28</td>
<td>21</td>
<td>.027*</td>
<td>2.28</td>
<td>65</td>
<td>51</td>
<td>.037*</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Barthel Index</td>
<td>-7.05</td>
<td>84</td>
<td>95</td>
<td>.000**</td>
<td>-5.19</td>
<td>71</td>
<td>88</td>
<td>.000**</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Houghton Score</td>
<td>-6.23</td>
<td>4</td>
<td>7</td>
<td>.000**</td>
<td>-5.17</td>
<td>5</td>
<td>7</td>
<td>.000**</td>
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<tr>
<td>Pain (VAS)</td>
<td>3.72</td>
<td>4</td>
<td>2</td>
<td>.001**</td>
<td>1.35</td>
<td>4</td>
<td>3</td>
<td>.20</td>
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<tr>
<td>EQ-5D</td>
<td>-1.78</td>
<td>69</td>
<td>78</td>
<td>.112</td>
<td>-2.67</td>
<td>62</td>
<td>73</td>
<td>.032*</td>
<td></td>
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</tr>
</tbody>
</table>

*Abbreviations.* 6MWT: 6 Minute Walk Test; TUG: Timed Up and Go Test; 10mWT: 10 Meter Walk Test
Table 9

One-Way Repeated Measures ANOVA to Analyze Differences in Mobility, ADL, Prosthesis Use, and Pain from T1 to T2 for Both Amputee Samples (Trans Tibial and Transfemoral Amputees), with “Time” (T) as Main Factor and „Time x Group“ (T x G) as Interaction

<table>
<thead>
<tr>
<th>Variables</th>
<th>T</th>
<th>T x G</th>
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<tr>
<td></td>
<td>Df</td>
<td>F</td>
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<tr>
<td>6MWT</td>
<td>1,49</td>
<td>6.6</td>
</tr>
<tr>
<td>TUG</td>
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<td>6.6</td>
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<tr>
<td>10mWT</td>
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<tr>
<td>Barthel Index</td>
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<td>Houghton Score</td>
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<tr>
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</tr>
<tr>
<td>EQ-5D</td>
<td>1,49</td>
<td>10.4</td>
</tr>
</tbody>
</table>

Abbreviations. 6MWT: 6 Minute Walk Test; TUG: Timed Up and Go Test; 10mWT: 10 Meter Walk Test

Discharge (T2)

ADL and prosthesis use at discharge were correlated with mobility. For the 6MWT, the TUG and the 10mWT, all correlations were significant. (H8). Regarding HRQOL, only the 6MWT correlated positively at discharge (see table 10).
Table 10

Pearson Correlation of Activities of Daily Living (Barthel Index)/ Prosthesis Use (Houghton Scale) and Different Mobility Tests (6MWT, TUG, 10mWT)

<table>
<thead>
<tr>
<th>Houghton Scale</th>
<th>Barthel Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson</td>
<td></td>
</tr>
<tr>
<td>coefficient</td>
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<tr>
<td>TUG</td>
<td>-.339</td>
</tr>
<tr>
<td>10mWT</td>
<td>-.355</td>
</tr>
</tbody>
</table>

Abbreviations. 6MWT: 6 Minute Walk Test; TUG: Timed Up and Go Test; 10mWT: 10 Meter Walk Test
7. DISCUSSION

In this thesis, amputees’ mental and physical health during inpatient orthopedic rehabilitation was examined using a broad range of different questionnaires and tests. It was analyzed whether amputees would benefit significantly regarding short-term mental health outcomes, HRQOL and physical parameters, and to which extent the outcome would differ compared to total arthroplasty patients. Furthermore, it was evaluated whether transtibial and transfemoral amputees would differ significantly regarding mobility, ADL, prosthesis use, pain and HRQOL outcomes. Results showed that LLA and TAP had no significant differences at admission, and that LLA as well as TAP could increase their mental health and their HRQOL outcomes throughout the course of the physical rehabilitation stay. Transtibial amputees started with significantly better mobility and ADL scores than transfemoral amputees at T1, and TTA and TFA could enhance the evaluated outcome parameters significantly from T1 and T2. Increased ADL and prosthesis use correlated highly significant with increased mobility. Moreover, TFA reported more phantom limb pain and higher general pain than TTA.

7.1. Descriptive Data

The investigated inpatient sample consisted of 50 amputated patients and 47 total arthroplasty patients. Overall, there was a balance of male and female patients. However, in the amputee group, the majority of patients were male, and in the TAP group, the majority was female. An unequal distribution of gender can influence the results, especially when it comes to the reporting of mental health issues or pain (Greenspan et al., 2007). Besides, women are more likely to consult psychological treatment (Mackenzie et al., 2006). This could be a reason for higher pain reports and decreased mental health in TAP, where women were predominant. Also, it could be an indicator for the high mental health scores at time of admission reported by the amputee group. One reason why in literature the majority of amputee samples are male could be the high number of studies which are embedded in a military background (Talbot et al., 2017; Ladlow et al., 2015; Ebrahimzadeh et al., 2009).

The mean age for both groups was 62.3 years. TAP were younger than LLA. In literature, age was found to be an important variable when it comes to an effective rehabilitation process (Scivoletto et al., 2003). However, the study of Scivoletto et al. (2003) implies that older patients generally tend to stay shorter in a rehabilitation setting than younger patients, which could not be confirmed in this thesis.
Employment rates in amputees were lower than in TAP, which could be related to age and disability level. The marital status in the two groups was comparable and was not found to have a relevant effect. In literature, however, the marital status is often considered a psychosocial variable and is shown to have an impact on physical health outcome (Czerniecki et al., 2017). Regarding the sociodemographic data of transtibial and transfemoral amputees, TFA in the sample were older than TTA. Age can be an indicator for a longer course of disease which might make additional surgery necessary.

The sample was divided into vascular and non-vascular diseases with regard to amputation cause. The number of vascular diseases as amputation cause was as high as expected, given to the fact that clinical samples which are not related to military services mainly consist of vascular disease patients. However, there are also studies which were conducted with trauma patients (Sjödahl et al., 2011; Dillingham et al., 2001). A comparison of vascular and non-vascular patients would have been interesting, as in literature trauma patients tend to report lower mental health and HRQOL scores. Due to the small number of trauma patients, it was decided to exclude such a comparison from the present analysis.

Phantom limb pain used to be more prevalent in TFA than in TTA. This could be explained by the higher rate of women in the TFA sample. There are studies which assume a higher pain prevalence in lower limb amputees (Ephraim et al., 2005), other studies found upper limb amputees to experience more PLP than lower limb amputees (Bosmans et al., 2010; Davidson, 2010). In fact, most of the times there is no difference made between TTA and TFA with regard to PLP. This topic has been researched quite well in the past and was therefore not a main target of this study. However, in this study PLP as well as general pain rates show a similar outcome to other studies (Davidson, 2010). Although PLP was not the study’s main focus, the patients’ PLP level was evaluated at admission together with socio-demographic data. The assessment of PLP and related variables at discharge would have been of interest, so general pain and PLP could be compared.

Compared to other studies which focused on a similar topic or had a similar design (see table 1), the sample size in this study was normal to high. Most importantly, the aim was to see an effect over time rather than between the groups, therefore the sample size was large enough for the present study aims.
7.2. Changes in Mental Health and HRQOL during Physical Rehabilitation

In this study, parameters of mental health and HRQOL of two groups, lower limb amputees (LLA) and total arthroplasty patients (TAP), were assessed during rehabilitation. Outcome differences were to be presented with regard to the different FKKS scales on body image, depression (BDI-II), and HRQOL (SF-36). The results could not confirm particular outcome differences at admission, yet there were outcome differences comparing T1 to T2, especially for body image scales and HRQOL mental health sum scale. Amputees improved especially concerning physical aspects and maintained their high mental health scores, whereas TAP could improve with regard to physical but also to mental health.

Other research focusing on these aspects, namely amputees and body image (Wetterhahn et al., 2002; Zidarov et al.; 2009 Holzer et al., 2014), amputees and depression (Asano et al., 2008; Darnall et al., 2005, Willrich et al., 2005), amputees and HRQOL (Zidarov et al., 2009; Sinha & Van den Heuvel, 2010; Zweynert et al., 2009), and different orthopedic inpatient groups during rehabilitation (Akira et al., 2009; Van Delft-Scheurs et al., 2014; Hampel et al., 2006), contributed with insights comparable to the results of the present study, e.g. regarding stable HRQOL of amputees throughout rehabilitation, or decreased MH in non-amputated patients at admission.

Remarkably few research papers regarding amputees and their body image can be found, although it has been considered one of the most important topics for amputees during psychological consultation in the rehabilitation center where the study was conducted. The questionnaires used for body image in other research papers were mostly the Amputation Body Image Scale Revised ABIS-R (Gallagher et al., 2007; Zidarov et al., 2009; Murray & Fox, 2002) and the Multidimensional Body Self Relation Questionnaire MBSRQ (Wetterhahn et al., 2002; Holzer et al., 2014). Published papers about amputation using the FKKS can hardly be found. One reason could be that it is a German questionnaire which in fact has been translated to other languages but might not have the same standing as the ABIS-R and the MBSRQ on an English-speaking level. The ABIS-R was specifically designed for amputees, which made it impossible to use for this study’s control group. The MBSRQ on the other hand, would be an interesting and comparable tool to the FKKS.
In their study, Wetterhahn and her colleagues (2002) aimed to examine body image in individuals with amputations and to determine if a relationship exists between body image and level of participation in physical activity. A positive relationship was found between regular participation in physical activity and body image among LLA. This underlines the present finding that improvement in physical health is correlated to an improved body image, and to increased scores in physical health and body image scales. Murray and Fox (2002) analyzed the relation between body image and prosthesis satisfaction. They found a close relationship between body image and prosthesis satisfaction, and saw these results as an implication for the importance of a good prosthesis service during rehabilitation. Holzer et al. (2014) compared body image and quality of life of amputees with healthy controls and found significant differences regarding body image and also quality of life. Lowered scores in body image and quality of life after limb loss, especially being compared to a sample of healthy controls, are assumable.

The most similar study design to the present study was the study of Zidarov et al. (2009), who analyzed body image in the course of three points over time. Patients seemed to have no decrease in their body image. Interestingly, in their study body image at discharge was lower and did not change in the course of the 3-month follow-up. Zidarov states that concerns about body image can be influenced by amputation cause and also time. The present study results, however, cannot concur with their finding, because at discharge, amputees had significantly increased their body image scores, especially with regard to the physical aspects. A follow-up study set at a later point in time could be interesting to evaluate if the increased scores at discharge are permanent.

In the present study, LLA’s body image changed regarding health and physical well-being, personal hygiene and outward appearance/physical efficiency. For TAP, changes were perceived rather in physical contact and physical acceptance by others. Surgeries seem to have a negative impact on TAP regarding body image as well. The significant changes in body image for both groups show how body perception can be affected by surgery in general, which has also been shown in other patient groups, e.g. patients with mastectomy (Collins et al., 2011).

With regard to depression, an interesting approach to this topic was done by Asano et al. (2008), who analyzed depression as predictor of quality of life of lower limb amputees. Their findings showed that especially depression had an influence on QOL after amputation, but also mobility, comorbidities and social participation. They emphasized
the importance of psychosocial adaption to limb loss after amputation, and also the fact that the focus of amputee rehabilitation programs still lies mainly on physical factors. From a sample of almost 1,000 persons with limb loss, Darnall et al. (2005) stated that significant depressive symptoms (28.7 %) were prevalent in this population. Furthermore, social circumstances like divorce or comorbidities, but also pain seemed to be risk factors for depression. Willrich et al. (2005) analyzed LLA patients with diabetes as amputation cause, and found no significant depressive symptomatic. In studies recruiting subjects among a military setting and/or traumatic accidents (Hawamdeh et al., 2008; Kazemi et al., 2013; Mckechnie, 2014), depression rates were comparably higher. In the present study, depression scores could be decreased although the score had no clinical relevance. It could be assumed that there might be a difference in affective disorders and anxiety disorders comparing trauma and vascular diseases as amputation causes. Traumatic accidents resulting in amputation might cause a higher prevalence regarding affective disorders than in samples as in the present study, where the main amputation cause arose from vascular diseases.

Analyzing the mental health of a non-amputee population during physical rehabilitation, Hampel and Moergel (2009) investigated and compared the effect of cognitive-behavioral management of depressive symptoms during an orthopedic rehabilitation stay with a chronic low back pain sample. Their findings showed that in a short- and mid-term measurement, a standard rehabilitation had no major effect on mental health whereas the rehabilitation which involved cognitive behavioral treatment in a short- and mid-term measurement showed beneficial effects on psychological parameters. This study underlines the present findings and lead to the conclusion that psychological support can help sub-populations in an orthopedic rehabilitation setting to prevent further chronicity.

In this study, HRQOL increased throughout the stay of both groups, mostly regarding physical health-related scales for LLA. They reported a higher-than-average mental health compared to other orthopedic patients or healthy population. This contradicts other study outcomes (Krops et al., 2017; Østlie et al., 2011; Sinha et al., 2011), which stated significantly lower outcomes on amputees in large samples. In a study by Ladlow et al. (2015), however, amputees from a military background were compared to healthy controls during the course of rehabilitation: Similar to the present results, military amputees achieved levels of functions which were comparable to those in age-matched healthy adults. Interestingly, the mental health outcomes were indicative for the
preparedness for full reintegration to society. In a military sample, other mental health issues can be more prevalent than in a predominantly vascular amputee sample, as argued in the discussion above. However, the importance which is given to a high MH score, is a good pioneer model for admission and discharge practices in physical rehabilitation.

Suckow and Stone (2015) tried to identify domains which were determined most important regarding quality of life by vascular amputees. Main determinants were mobility, impairment, pain and emotional perturbation. This concurs with the present results, especially regarding the physical changes. Also, the results of Zidarov et al. (2009) concurred with the present results. They measured HRQOL with SF-36 at admission (T1), discharge (T2) and in a 3-months follow-up (T3). In their study, HRQOL was stable throughout the three points in time. This as well concurs with the findings of Zweynert et al. (2009), who analyzed the HRQOL of general orthopedic patients who increased their HRQOL throughout the course of their stay.

The noticeable high MH sum score reported by LLA leads to the question whether this could underline the response shift theory by Schwartz et al. (2006). The response shift theory is closely related to the concept of HRQOL. Paradoxically, patients after life-threatening events describe a quite good quality of life comparable to healthy or less impaired patients. This comes as a consequence of a natural and important adjustment process after e.g. chronic illness or disability. Response shift and coping are tightly related concepts, as coping behavior can lead to a re-evaluation of a disease. Coping can therefore be responsible for a response shift, given the measured parameter is strongly influenced by the new circumstances. Nonetheless, a response shift also occurs without coping, since the handling of the new situation does not necessarily have to be positive. For the present setting this relates to the fact that HRQOL, especially MH, is known for being significantly decreased directly after surgery. Once the patient gets used to his new circumstances, a response shift is taking place. Throughout the course of the rehabilitation stay the results are not varying significantly for amputees, which leads to the assumption that if there was a response shift, it might have taken place between hospital stay and before rehabilitation stay, which is affirmed by the clinical study of Schwartz and his colleagues.

Another influencing reason for improved MH might be the treatment conditions. In the present rehabilitative setting, amputated patients are required to complete a psychological initial interview where the psychologist together with the patient decides
whether further psychological counselling is needed. In contrast, the non-amputated patients are able to voluntarily choose psychological counselling as part of their rehabilitation schedule.

With regard to patients with severe injuries but no amputation, Van Delft-Schreurs et al. (2014) conducted a study evaluating the psychological complaints of patients. Most of the assessed patients (over 70 %) obtained their injuries from traffic accidents or at home. Up to 30 % of the investigated patients showed psychological complaints. There was no correlation between psychological complaints and somatic severity or type of injury found. The quality of life of severely injured patients was impaired in comparison to a norm population, but only for the injured patients who were dealing with psychological complaints. This study shows that psychological complaints seem to be an important and underestimated parameter for a decrease in QOL among severely injured patients.

In the study of Akira et al. (2011) patients who underwent a total hip arthroplasty (THA) were assessed regarding HRQOL by using the SF-36 in two follow-ups, one after 6 months and the second about one year after surgery. It was shown that physical health and mental health scales were both affected after THA. The results help to understand the situation and arising needs of a non-amputee population. Patients who underwent surgery might not experience the same traumatic incision as at an amputation, but it might still impact their mental well-being before rehabilitation. Another reason for the significant improvement in mental health of non-amputated patients might lie in the reduced pain sensation. Many non-amputated patients are dealing with chronic pain (Michalski et al., 2009) which is associated with lowered quality of life such as depressive behavior (Ide et al., 2011).

Using different tools for evaluating HRQOL (SF-36 and EQ-5D) was helpful to compare potential outcome differences. In a study of Picavet et al. (2004), both questionnaires were used and similar outcomes were shown. This concurs with the present results. However, results of the EQ-5D in some cases differed from the SF-36 results, and the present study found the SF-36 to be more precise on information, which is given to the fact that it is more complex than the EQ-5D consisting only of 5 questions. Therefore, the EQ-5D is often compared to the short versions of the SF-36, SF-6D or SF-12. In this study however, the research interest was on having detailed information about HRQOL changes rather than a detailed analysis between two different tests. Therefore, the EQ-5D was only used for an objective clinical surveillance in the second study.
It might be interesting to discuss how to define mental health with regard to orthopedic rehabilitation for the future. As observed in the discussed studies, mental health is seen as the equivalent of one parameter, e.g. depression or quality of life. This present study, however, aimed to create a broader range of mental health including body image, which is one of the most relevant parameters after limb loss. Depression is one of the most prevalent comorbid psychiatric diseases. Also HRQOL contains psychological variables, as it has its own mental health sum score. From this point of view, the mental health evaluation in this study can be considered as adequate. However, it would be of interest to define mental health evaluation standards for patients during orthopedic rehabilitation. For future research, it would be interesting to compare samples with vascular diseases as amputation cause to samples with traumatic accidents, especially regarding psychological variables such as drug abuse, anxiety, PTSD or mild cognitive impairments.

7.3. Differences in Transtibial Amputees Compared to Transfemoral Amputees

TTA and TFA were compared regarding different outcome variables including mobility, ADL, prosthesis use, pain, and HRQOL. Outcomes showed that TTA started from a higher level in almost all scores. Besides, results showed that both groups enhanced their performances significantly over time. Increased ADL and prosthesis use was significantly correlated with increased mobility at discharge. Overall, pain was more prevalent in TFA.

The results of the present study concurred with findings from most of the studies described above regarding aspects such as the improvement of mobility but also differences between TTA and TFA, especially at admission to rehabilitation. The improved mobility for both groups also concur with former results (Larsen et al., 2012; Davis and Datta, 2003). General pain sensation could be significantly reduced from T1 to T2. Increased pain concurs with the hypothesis that chronic pain after orthopedic surgery is a common phenomenon (Michalski et al., 2009).

There is a number of studies examining mobility in amputees (Davies and Datta, 2003; Fortington et al., 2012; Norvell et al., 2011). Pain phenomena in amputees are also a well-researched topic (Davidson et al., 2010; Ephraim et al., 2005; Bosmans et al., 2010). These studies concur regarding lowered mobility rates, higher pain levels, and therefore a reduced quality of life. However, most of the studies focus specifically on phantom limb
pain. Also, different results for comparison on prosthesis use (Banghu et al., 2009; Murray and Fox, 2002; Webster et al., 2012) and ADL performance (Ladlow et al., 2015; Zidarov et al., 2009) can be found in literature.

The majority of studies use the same mobility tests (6MWT, TUG, 10mWT) which were used for the present study since these are chosen and used according to rehabilitation standards. Regarding the walking abilities of amputees, the present results concur with the improvement of mobility in related studies (Norvell et al., 2011). Walking is in fact one of the most important orthopedic rehabilitation goals. Novell and his colleagues showed that mobility success is closely linked to general satisfaction and considered as one of the most relevant outcome variables regarding physical health of amputees. In their study, no significant differences between TTA and TFA were proven regarding mobility success, however, there was a trend that the rate in TTA was higher. This concurs partially with the present results where TTA scored significantly higher at admission, but over the course of rehabilitation the differences between the two groups were partly not significant anymore.

A study of Rau et al. (2007) showed that short-term physiotherapy has a significant effect on functional performance of LLA. Different walking ability tests were performed at admission and after intervention and the improvement of the experimental group showed significantly higher improvements in walking ability compared to the controls. However, no differences between TTA and TFA were identified, and psychosocial indicators were not taken into consideration for this study.

Bhangu et al. (2009) compared TTA and TFA with vascular amputation causes and observed differences concerning the amputation level, especially regarding ambulation, activity and prosthesis use. Although both groups were able to improve their general mobility level, the results concurred with a former study by Datta and Davies (2003) that TFA performed lower. Davies and Datta stated that the older the amputees were and the higher the amputation level was, the lower the level of mobility was. This accorded with a central part of the present assumption.

Mobility apparently differs by age. Fortington et al. (2012) focused their research on papers examining the walking abilities in elderly amputees. The results showed that elderly lower limb amputees in general were able to achieve a good level of mobility. As the present amputee sample can be considered to also represent an elderly population, these results are a relevant prognosis for the success in elderly amputees’ rehabilitation.
TTA tend to show a better performance, but the course of performance in both groups show the crucial impact of rehabilitation, especially for TFA. A reason for the harmonization of performance in the two groups could be related to the adaption of mobility. Prinsen et al. (2011) showed in their systematic review that TTA and TFA used remarkably similar adaptation strategies to compensate the loss of a limb. This study confirms the overall health improvement of TTA and TFA during orthopedic rehabilitation.

TTA such as TFA enhanced their performance significantly in prosthesis use (Houghton Scale) and ADL (Barthel Index). Prosthesis use is always linked to mobility in the rehabilitation process and can be found in various studies. A negative correlation of prosthesis use and impaired body image, as shown in a study of Murray and Fox (2002), was not found, although better performance in prosthesis use and the scale on Personal Hygiene and Outward Appearance correlated significantly positive. The present finding is in line with the importance of prosthesis use which was shown in a study of Webster et al. (2012). A significant connection between successful prosthesis use and psychosocial variables was shown, but also a difference between successful prosthesis use and amputation level. TFA were found to have a reduced walking time. This points out the importance of a guided inpatient rehabilitation where prosthesis use and learning of ADL is scheduled on a regular basis.

Behr et al. (2008) analyzed pain sensation comparing TTA and TFA. There was no difference regarding pain sensation, including PLP, residual limb pain and back pain between TTA and TFA. Yet, it needs to be taken into consideration that amputation in the majority of cases was of traumatic origin, which in the present study is mainly not the case. Additionally, time since amputation time was on average 12 years, a fact which makes a comparison more difficult and which could be a reason for the different study outcomes. Still, the results can give an interesting insight on long-term development of pain sensations in amputees.

Clark et al. (2013) on the other hand raised the question whether there was a difference in PLP comparing diabetic to non-diabetic amputees. Their findings showed no difference in pain sensations with regard to the amputation cause. Michalski et al (2009) evaluated pain perception in an amputee population during rehabilitation. During the rehabilitation process, a decrease in pain could be demonstrated, which underlines existing evidence that rehabilitation can be effective for pain reduction during orthopedic rehabilitation.
Davison et al. (2010) compared upper limb amputees to lower limb amputees regarding pain and HRQOL. Their results showed that upper limb amputees are more likely to suffer from post-amputation pain than lower limb amputees, and that the whole amputee sample scored significantly lower than the norm population. In their study they also showed that TTA and TFA could reduce pain but only TTA reduced it significantly throughout the course of their stay. Pain level in TFA was reported to be higher, especially regarding PLP. In literature, PLP still is a phenomenon in research literature with multiple theories about its etiology and causal links and a theory for increased PLP in TFA has been not carried out so far. This outcome contradicts the outcome of the prevalence study of Kern et al. (2009) where no significant differences in PLP and phantom sensation were found between TFA and TTA. However, the time frame of amputation is not described, neither is reported whether amputees underwent rehabilitation. An explanation for increased pain might be that TFA could have a longer pain history due to revision surgeries, which could be related to the theory of pain memory (Flor, 2006). The fact that TTA reduced their pain level throughout the course of the stay could be linked to a higher increase in mobility compared to TFA. Yet, increased mobility and decreased pain were not significantly correlated.

There are some important key learning points which can be taken out of the study. The results show that TFA have numerous disadvantages when starting inpatient rehabilitation compared to TTA. They start at a different performance level regarding mobility and overall physical health status. Nonetheless, they benefit as much as TTA or even more during orthopedic rehabilitation. In fact, it shows that the more impaired the health status is, the more important inpatient rehabilitation stay is. Otherwise patients most probably will not be able to regain abilities which are vital for their daily living. Results show that TTA start from a different performance level, recover quicker, report less pain and report an overall better physical and mental health. If a transfemoral amputation is inevitable, orthopedic inpatient rehabilitation should be an indispensable component of recovery.

The study sample was relatively small, therefore it is difficult to make general assumptions on outcome differences between TTA and TFA. Yet, the most relevant aspects of orthopedic rehabilitation for amputees, which are different to the TAP sample and can therefore not be compared (e.g. prosthesis use and PLP), were taken into consideration. Besides, an excerpt of studies comparable to the present one (see table 1) shows that amputee populations in research tend to be small.
7.4. Conclusion

In summary, the current findings have important clinical implications for a better comprehension of mental health and its related parameters during the physical health recovery of amputees in orthopedic inpatient rehabilitation.

Decreased mental health and HRQOL after a major life event like an amputation can be assumed. Nevertheless, a deeper and detailed insight of aspects of mental health which are involved in the rehabilitation process is lacking. Therefore, a multidimensional approach for the rehabilitation period seems to be beneficial with regard to medical and psychological interventions during inpatient orthopedic rehabilitation. In the studies that were discussed in this thesis, aspects of mental health are being analyzed, but none covers all aspects of mental health, HRQOL, and physical parameters. Besides, the rehabilitation perspective is often not taken into consideration, as studies focus on post-amputation but it is not clear which rehabilitation interventions have been done or in which settings interventions have been carried out. Literature does not reveal many studies about mental health in physical rehabilitation, except for studies which analyze military samples. Nevertheless, it is not helpful to take them into consideration for comparison, as amputation cause, gender, age and treatment standards differ too much from other populations. Analyzing the research literature of the past decade, many research questions about mental conditions during or after orthopedic rehabilitation like the patient’s well-being remain unanswered. A possible reason can be the lack of possibilities for carrying out research directly at rehabilitation centers as they, geographically and with regard to research content, are often not linked to university settings.

This thesis can only reflect a limited period in the lives of individuals undergoing major surgeries. A major implication for future research results could be the use of a post-measurement, as the present studies focused on a short-term period and it is not possible to predict long-term effects of orthopedic rehabilitation. Nevertheless, the short-term goal of the present study, that during rehabilitation patients tend to increase mental health given to a better physical health and less pain, was proven right. It could be proven that physical rehabilitation seems to have a positive effect on short-term mental health and HRQOL outcomes not only for amputees, but also for non-amputated patients. It might have been interesting to have an additional healthy population sample (in addition to the TAP sample). However, norm population values for German speaking countries were provided for all mental health and HRQOL questionnaires for reference purposes.
In further studies, it will be helpful to gather more data to support the existing results, but also to add a longitudinal evaluation component. In addition, more mental health variables could be analyzed. It might be interesting to put a focus on the effect of specific psychological treatment interventions (e.g. cognitive behavioral therapy) for amputees during rehabilitation. Finally, it would be interesting to deepen research on mental health of TAP during orthopedic rehabilitation as well, since their mental well-being seems to be at risk, too.
REFERENCES


consumption, and length of stay. *Archives of orthopaedic and trauma surgery*, 132(8), 1153-1163.


assess determinants of the lower-limb amputee’s ability to ambulate. *Archives of physical medicine and rehabilitation*, 83(5), 613-627.


(178) Tlach, L., & Hampel, P. (2011). Long-term effects of a cognitive-behavioral training program for the management of depressive symptoms among patients in


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Appendix

Computerized psychological tests were executed with the Hogrefe Test System (HTS):

- SF-36
- FKKS

Non-computerized material for the assessment (excerpts):

- Declaration of Consent
- Sociodemographic Data
- BDI-II
Patientinneninformation und Einwilligungserklärung
durchgeführt an der Beobachtungsstudie

Amputierte Patienten in der Orthopädischen Rehabilitation: Psychosoziale
Konsequenzen und Aussichten in der psycho-rehabilitativen Behandlung

Sehr geehrte(r) Teilnehmende(r), sehr geehrter Teilnehmer!

Wir laden Sie ein an der oben genannten Beobachtungsstudie teilzunehmen. Die Aufklärung
derüber erfolgt in einem ausführlichen Gespräch.

Ihre Teilnahme an dieser Studie erfolgt freiwillig. Sie können jederzeit ohne Angabe von
Gründen aus der Studie ausscheiden. Die Ablehnung der Teilnahme oder ein vorzeitiges
Ausscheiden aus dieser Studie hat keine nachteiligen Folgen für Ihre medizinische
Behandlung.

Beobachtungsstudien sind Studien, bei denen in der Regel nur Daten aufgenommen und
verwahrt werden, die im Rahmen der normalen Patientenversorgung entstehen. In manchen
Fällen kann es auch sein, dass zusätzliche, nicht belastende Untersuchungen oder Behandlungen
vorgenommen werden. In keinem Fall wird die für Sie vorgesehene Behandlung durch Ihre
Studienteilnahme verändert. Beobachtungsstudien sind notwendig, um zusätzliche Erkenntnisse
über bereits bewährte medizinische Verfahren zu gewinnen.

Zu dieser Beobachtungsstudie, sowie zur Patienteninformation und Einwilligungserklärung
wurde von der zuständigen Ethikkommission eine beauftragende Stellungnahme abgegeben.

1. Was ist der Zweck dieser Studie?

Der Zweck dieser Beobachtungsstudie besteht darin, die psychosozialen Veränderungen und Folgen
für Patienten nach der Amputation grundlegend zu untersuchen, vor allem hinsichtlich des
Einflusses körperlicher und mentaler Rehabilitation. Dies soll durch die Anwendung
verschiedener Fragebögen (z.B. SF-36, McGill, BDI-II, EQ-5D) sowie bereits vorliegenden
und erhobenen Patientendaten durchgeführt werden. Ein weiterer Ziel ist es, die Wirkung und
durch effektive, mögliche Veränderungen von (Phantom-)Schmerzen durch
Biofeedback-Training zu analysieren. Biofeedback bedeutet, dass körperliche Parameter wie
Atmung und Temperatur über (am Finger) angelegte Elektroden gemessen und auf dem PC
durch eine Software übertragen werden. Durch diese Visualisierung kann man mit den
jeweiligen Patienten Strategien entwickeln, um selbständige Einfluss auf körperliche
Vorgänge zu nehmen (z.B. Temperaturregulierung, Kontrolle der Atmung).

2. Wie läuft die Beobachtungsstudie ab?
Psychosoziale Dokumentation

Amputation: ja / nein
Amputationsdatum:

Amputationsursache:
Amputations-Art:

Erkrankung:

Nebendiagnose:

Status:

PLP: ja / nein

Phantomgefühl: ja / nein

Häufigkeit

Intensität

Beeinträchtigung

Anderer Schmerz:

Alkohol: ja / nein
Menge:

Nikotin: ja / nein
Menge:
### Fragebogen

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Diese Arbeit widme ich meinen geliebten Eltern, Telma Gonzales und Meinrad Armbruster.
Curriculum Vitae

Personal Data

Name: Chaska Malena Armbruster
Date of Birth: 08/12/1987
Place of Birth: Heidelberg, Germany
Languages: German (native), Spanish (native), English (fluent, IELTS Score: 8.0), French (advanced), Italian (basic)

Working Experience

02/2015 – now  SCHUHFRIED GmbH
- International Sales Manager (Key Account, Business Development)
- Global Product Manager Biofeedback
- Internal Training for Medical Device Consultant

09/2013 – 01/2015  Orthopedic Rehabilitation Center Zicksee
- Clinical Psychologist/ PhD Student

07/2014 – 2015  Private Practice
- Psychological Counselling

11/2013 – 2015  Medical University of Vienna/ Orthopedic Rehabilitation Center Zicksee
- Junior Research Associate
- Research and analysis for a multicenter study about mobility after amputation

11/2011 – 10/2012  Institute for Entrepreneurship & Innovation, Vienna University of Economics
- Project Manager of Social Impact Award
Education

03/2013 – now Medical University of Vienna, Austria
  - PhD Studies in Applied Medical Sciences (Program: Mental Health and Behavioral Medicine)
  - Academic degree: Dr.scient.med.

02/2015 – 11/2015 Association of Austrian Psychologists (BOEP)
  - Postgraduate Program: Occupational Psychology

10/2012 – 7/2013 Postgraduate Center, University of Vienna
  - Postgraduate Program: Clinical & Health Psychology
  - Diploma with distinction

10/2006 – 6/2011 University of Salzburg, Austria
  - Psychology, concentration: Biological Psychology, Clinical Psychology
  - Academic degree: Mag rer. nat.
  - Degree: Diploma

  - Degree: Abitur (High school diploma)

10/1993 – 07/1997 Mönchhof-Grundschule, Heidelberg, Germany
  - Primary School

International Experience/ Internships

12/2012 – 07/2013 Department of Orthopedics (AKH), Medical University of Vienna, Austria
• Internship for Clinical and Health Psychologist

07/2009 – 09/2009   ASHOKA Youth Venture, Berlin, Germany

• Psychology/ Social entrepreneurship internship

03/2006 – 06/2006   NGO Puririsun, Cusco, Peru

• Social & teaching internship with preschool-children


• Human Resources & Communitary Relations internship

**Further Education and Scholarships**

10/2014   European Health Forum Gastein

• Scholarship for “Young Forum Gastein”

08/2014   European Forum Alpbach

• Scholarship for Summer School “European Health Care and Social Systems”
  • Diploma with distinction

03/2013   Crisis Intervention Center, Vienna

• Psychological Seminar: Basics of crisis intervention

10/2008 – 05/2013 Sigmund Freud Private University, Vienna, Austria

• Extension studies and qualification as Biofeedback Therapist

06/2010 – 06/2011 AIESEC Salzburg, Austria

• Local Committee President
  • Supervision and management of areas: Human Resources, Sales, Finance, Communications & PR, Outgoing Exchange
07/2010 – 07/2011 Theodor-Heuss-Kolleg, Berlin, Germany

- One-Year Scholarship
- Community involvement through project implementation and workshops, promotion of intercultural cooperation

Publications

Reviewer Activities

Since 2017 Reviewer for “Disability and Rehabilitation”

Publications (under review)


Publications


Oral Presentations (excerpt)

03/2017 CIPSEVI Iberoamerican Road Safety Police Congress, Puente Genil, Spain

09/2016 Slovenian Psychology Congress, Krajnska Gora, Slovenia

06/2015 RehabWeek 2015, Valencia, Spain

05/2014 EMSOS 2014 - 27th Annual Meeting of the European Musculo-Skeletal Oncology Society (E.M.S.O.S.)
Topic: “Psychosocial Consequences and Pain after Amputation – An Austrian Long-Term Survey”

06/2013/2014 Medical University of Vienna (YSA PhD Symposium)
Poster Presentation: The effect of mental training methods in phantom limb pain treatment

07/2013 13th European Congress of Psychology
Topic: The Effect of Discontinuous SMR Neurofeedback Training on Attention and Concentration

12/2012 CCC Comprehensive Cancer Center Vienna
Topic: Sexuality in the process of disease

12/2012 PricewaterhouseCoopers, Vienna
Health Days, Topic: Biofeedback