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REHABILITATION AFTER LOWER LIMB AMPUTATION: BETWEEN FUNCTIONAL RECOVERY AND QUALITY OF LIFE

Abstract. Below knee amputation is a big operation with far-reaching effects on the physical, psychological and social life of the patient. The most common reasons for an amputation are vascular disease, diabetes complications and traumatic injuries. In worldwide epidemiological research amputation rates scored highly with wide differences according to the country and access of medical service. For instance, one rate of 22.5 cases/100 000 per year was reported in Canada, with predomination in males over the age group of 65 years. The rate of amputation among American Indians is also three times the U.S. average. The use of procedures is extremely variable in European and Asian countries, with the highest rates being found for UK and the lowest for Japan. In the United States, hospitalization rates for non-traumatic amputation of a lower extremity decreased by over 50% from 1988 to 2008. In Germany and Italy also, prevalence of amputations among the elderly patients with complicated diabetes or PAD is very high. Objective: To review the scientific research regarding physical therapy of individuals with lower limb amputation. Materials and methods. A literature search was performed in the Scopus, PubMed and Google Scholar databases with search terms related to rehabilitation after LLA. Different dimensions of postamputation rehabilitation – physical, psychosocial, and emotional recovery – are useful for patients to start prior to surgery. Early physiotherapy, choice of prosthesis and psychological therapy are important in the rehabilitation process. End, virtual rehabilitation electrostimulation, mirror therapy and hydrotherapy have been demonstrated effective particularly in various stages of treatment. In the elderly, multidisciplinary treatment in conjunction with the individualization of loads and recovery phases with a slow progression can enhance success. It has been demonstrated

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that even patients older than 80 years can achieve functional recovery by appropriate treatment. Already 3 months post-rehabilitation there are signs of positive quality of life development, particularly with sustenance support. Early rehabilitation cuts annual mortality by 30% and increases the likelihood of successful prosthetic adaptation. Current guidelines are towards the use of biomechanical analysis, psychological counselling and incorporating nurses in patient daily care. Therefore, the rehabilitation of a patient with lower extremity amputation requires holistic management program with an early onset program, multidisciplinary involvement and customized programs. In this way not only functional capacities are recovered, but also quality of life and social integration can be enhanced in these patients.

Keywords: lower limb amputation, physical rehabilitation, prosthetics, functional recovery, quality of life, postoperative adaptation, orthopedic care.

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РЕАБІЛІТАЦІЯ ПІСЛЯ АМПУТАЦІЇ НИЖНІХ КІНЦІВОК: МІЖ ФУНКЦІОНАЛЬНИМ ВІДНОВЛЕННЯМ І ЯКІСТЮ ЖИТТЯ

Анотація. Ампутація нижче коліна – це велика операція з далекосяжним впливом на фізичне, психологічне та соціальне життя пацієнта. Найпоширенішими причинами ампутації є судинні захворювання, ускладнення діабету та травматичні ушкодження. У світових епідеміологічних дослідженнях показники ампутації отримали результати з значними відмінностями залежно від країни та доступу до медичних послуг. Наприклад, в Канаді було зареєстровано показник у 22,5 випадків/100 000 на рік, з перевагою у чоловіків старше 65 років. Показник ампутації серед американських індіанців утричі перевищує середній показник по США. Використання процедур надзвичайно варіабельне в європейських та азійських країнах, причому найвищі показники спостерігаються у Великій Британії, а найнижчі – у Японії. У Сполучених Штатах показники госпіталізації з приводу нетравматичної ампутації нижньої кінцівки знизилися більш ніж на 50% з 1988 по 2008 рік. У Німеччині та Італії також поширеність ампутацій серед

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літніх пацієнтів з ускладненим діабетом або захворюванням периферичних артерій є дуже високою. Мета. Оглянути наукові дослідження щодо фізичної реабілітації людей з ампутацією нижньої кінцівки. Матеріали та методи. Було проведено пошук літератури в базах даних Scopus, PubMed та Google Scholar з використанням пошукових термінів, пов'язаних з реабілітацією після **ампутації нижніх кінцівок**. Різні аспекти постампутаційної реабілітації – фізичне, психосоціальне та емоційне відновлення – корисні для пацієнтів, які слід розпочати до операції. Рання фізіотерапія, вибір протеза та психологічна терапія є важливими в процесі реабілітації. Кінцева, віртуальна реабілітація, електростимуляція, дзеркальна терапія та гідротерапія виявилися ефективними, особливо на різних етапах лікування. У людей похилого віку мультидисциплінарне лікування в поєднанні з індивідуалізацією навантажень та фаз відновлення з повільним прогресуванням може підвищити успіх. Було продемонстровано, що навіть пацієнти старше 80 років можуть досягти функціонального відновлення за допомогою відповідного лікування. Вже через 3 місяці після реабілітації спостерігаються ознаки позитивного розвитку якості життя, особливо за умови підтримки. Рання реабілітація знижує річну смертність на 30% та підвищує ймовірність успішної адаптації протезів. Поточні рекомендації спрямовані на використання біомеханічного аналізу, психологічного консультування та залучення медсестер до щоденного догляду за пацієнтами. Тому реабілітація пацієнта з ампутацією нижніх кінцівок вимагає цілісної програми ведення з раннім початком, мультидисциплінарною участю та індивідуальними програмами. Таким чином, відновлюються не лише функціональні можливості, але й покращується якість життя та соціальна інтеграція цих пацієнтів.

Ключові слова: ампутація нижньої кінцівки, фізична реабілітація, протезування, функціональне відновлення, якість життя, післяопераційна адаптація, ортопедична допомога.

Statement of the problem. LLA (lower limb amputation) is a major surgery with serious physical, psychological and social implications for the patient. It is most frequently due to progressive vascular disease, diabetes-related complications or trauma. As Moxey et al. the global prevalence of lower limb amputation varies widely according to region, economic development and presence of well-functioning prevention and treatment services. For instance, the incidence of LEA as it conditions with the U.S.A. and Canada is lower than that in Africa or Asia and usually it is related to early limb ischemia and diabetic lesions treatment [1]. The authors stress that as people grow older, the prevalence of amputation even in advanced medical systems grows and is much higher in men.

In Canada, a study by Imam et al found for the past decade an incidence of lower limb amputation rate was approximately 22.5 per 100,000 person-years and it has been found with substantial gender and age differences as well. The highest rate was observed in men older than 65 years, which would likely correspond to a combination

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of vascular pathology due to aging, diabetes and lower levels of physical activity [2]. It should be pointed out that the increase of obesity, metabolic syndrome and type 2 diabetes has a direct impact on the surgical procedures within the population.

The Strong Heart Study also reports similar findings in the U.S. indigenous population, where the diabetes-related lower limb amputation rate was 5.5 per 1,000 person-years of follow up. This is three times the national average. Significant risk factors consisted of prolonged uncontrolled hyperglycemia and inadequate health services in remote regions [3].

A multicentre global study in Europe, North America and east Asia concluded that the United Kingdom had the highest case rate of lower limb amputations and Japan the lowest [4].

Meanwhile in the United States, a sizeable reduction in the hospitalization rate for non-traumatic lower limb amputations among US patients with diabetes aged 40 years and older from 1988 to 2008 was reported by Li et al. The rate dropped from 11.2 to 4.9 per 10,000 people, which the authors attribute to increased glycemic control and range of diabetic foot care programs as well a multidisciplinary team [5].

A population-based study conducted in Spain between 1989 and 1999 demonstrated a stable incidence of non-traumatic amputations, which was approximately 1.8/10,000 inhabitants in the Madrid region. Sixty-one per cent underwent an above-hip amputation, indicative of late diagnosis and treatment for the underlying condition [6].

A German study by Kröger et al. reports the number of lower limb amputations in Germany to exceed 30,000 per year during 2005-2014 predominantly among subjects suffering from severe peripheral arterial disease [7]. Even with a good healthcare system, many amputations are being performed in advanced cases due to patients' lack of willingness or inability to search for care early.

In Italy, the disabled amputee population was estimated by Lombardo et alii between 8,000-9,000 per year from 2001-2010 in an analysis based on data referring to lower-limb amputations. Diabetic patients had a 20 times higher amputation risk compared with the general population, and their average age was over 65 years [8].

The aim of the study is to conduct an analysis of scientific sources regarding modern methods of rehabilitation of people after lower limb amputation.

Research objects and methods. A search was conducted for scientific publications related to the topic of rehabilitation of individuals after amputation of one or both lower limbs in the scientometric databases Scopus, Google Scholar, and PubMed. The search was conducted according to keywords related to the topic of the publication.

Presentation of the main material.

Research results and their discussion. Rehabilitation of patients after lower extremity amputation is a difficult and complex process involving three areas of recovery: physical, psychological and social. Marshall, Barakat, and Stansby point out that optimal rehabilitation should be guided by holistic principles of care which commence pre-operatively with pre-amputation counseling, post-amputation through

early mobilization, prosthesis fitting and longer term patient support [9]. Its primary goals include avoiding contractures, regaining muscle strength and maintaining balance, coordination and general mobility. The authors note that early referrals to specialized rehab services help the patient gain a greater degree of independence during this initial phase of recovery. It is also necessary to consider the individual characteristics of each patient – age, level of amputation and presence of comorbidities. Care after surgery should integrate physiotherapeutic and psycho-social treatment. The project depends mainly on the combined efforts of a team of specialists for its success.

Ülger et al. in their review, present a variety of physiotherapy interventions including: electrical stimulation, hydrotherapy, virtual rehabilitation and stability/coordination training [10]. They observe that the efficacy of the approaches is dependent on the treatment phase: in the acute phase, pain management and complications avoidance are preferred, whereas in the chronic phase rehabilitation to prostheses. its effective management is based on individualized techniques of selection and evidence-based approach of physical therapy. Especially promising seemed to be the application of mirror therapy antiphantom pain and virtual rehabilitation for recovery spatial perception and motor planning. An integrated approach offers the potential to optimize functional independence and speed reintegration into daily life.

The rehabilitation of the old patient, particularly after amputation, is a specific field. Cutson and Bongiorni explain that rehabilitation in older patients is challenged by comorbidities, poor endurance and motivation [11]. They stress the importance of multidisciplinary approach, also including others therapies like social work and psychotherapy next to physical therapy. Successful re-habilitation in this population decrease the risk of future hospitalization, minimize falls and support for quality of life. Therapy should be 'dosed', individualised and performed in a safe environment under careful medical supervision. The factors that contribute to success are family support, independence prior to surgery and postoperative care. A study has been conducted by Frengopoulos et al. suggests that even patients of over 80 years old can achieve functional rehabilitation following amputation, if well managed [12]. In most studies, more then half of patients in this age group become functionally independent with the help utensils or prostheses. But time to prosthesis implantation is frequently still long and use of further resources and interprofessional approach are necessary. The successful rehabilitation of elderly patients does not only mean to recover the function but also preserve quality of life, isolation and dependency with cotidian human care. Furthermore, the authors stress that functional potential should be accurately screened before initial intensive care support.

Blair, Zidarov et al [13] Addressed quality of life during rehabilitation and for 3 months post-prosthetic fitting in lower limb amputees. They reported there had been a statistically significant improvement in mobility, self-care and social interaction in the HUI3 and LCI instruments. Learning the use of prosthesis and learning to regain balance are critical components during the phase of inpatient rehabilitation. After 3 months, the improvement was kept highly significant in some domains (emotional

state, fatigue), while others required additional reinforcement. This implies that the adaptation process is long-term and not completed at discharge from hospital. The researchers suggest a future increase in post-acute outpatient support for these patients.

Pande et al. showed that early participation in rehabilitation was correlated with a 30% decrease in 1-year mortality of patients following amputation [14]. The need for a physiotherapy program as early at 3-5 days after surgery is emphasized by the authors. Furthermore, the activity of comorbid diseases and nutrition status as well as prevention of decubitus ulcers must be paid attention to. If a prostheses is fitted in time, both the survival of the patient and his quality of life improve proportionately well when an integral treatment strategy is pursued.

A positive correlation between compliance and adaptation, based on a range of follow-up studies, was also found in the 15-year clinical follow-up study of Hordacre et al. indicating that adaption to the prosthesis was achieved by 73% patients who had completed physiotherapy program [15]. Patients with high levels of amputation (above knee) and low motivation had the most problems. This finding supports the feasibility of categorizing rehabilitation on the basis of amputation level. The authors also underscore the importance of periodic evaluation of successes and modifications to the rehab plan. The comprehensive treatment comprised training of the cardiorespiratory system, gait retraining, balance exercises and psycho-emotional support.

Fiedler et al. stress the significance of applying biomechanical methods within the rehabilitation, namely gait analysis and body posture control [16]. It, therefore, is never available to prevent injuries as well as for the increased efficacy of prosthesis applications. The new computerized monitoring systems make it possible to objectify the patient development. In addition, this study underscores the importance of considering the functional asymmetric loading of the trunk that results from amputation. Robotic and perturbed devices facilitate symmetrical movement and endurance training.

A study of 100 patients reported by McWhinnie et al. demonstrated that only 60% were continuing to be prostolized and physically active after a mean period of 5yr following an amputation [17]. The best outcomes were obtained in younger patients without co-morbidities who commenced rehabilitation early. The authors stress that the main issue is not only simply physical preparation but also a psychological one. Long-term functional independence was more likely in patients with family support and multidisciplinary services available.

Shelmerdine and Stansby stress the importance of early preoperative conditioning, not just with physical training, but also mental and psychological adaptation [18]. This results in less apprehension, better compliance and a shorter duration of postoperative hospitalization. The role played by multidisciplinary rehabilitation teams and the relevance of ongoing medical support following hospital discharge is also addressed.

Kelly and Dowling target nursing care in the rehabilitation of patients with lower limb amputation. [19] They suggest that nurses are in the frontline for daily control of

tormentum state, pain assessment, directing nutrition and psychoemotional support. Specific nursing education also should be offered about caring for patients who have had an amputation, especially in the prosthetic phase. They too put the need for human service personnel contact with the patient as a positive perception toward the recovery process.

Rau et al found that a short period of physiotherapy could significantly improve function related to amputee individuals (balance, walking speed, chair rise) after 3 weeks [20]. This reveals us that even short, intensive interventions can be very effective if they are framed. The authors do stress that therapy after the child is discharged is important to "cement in" this progress.

Fajardo-Martos et al. discovered that the factors predicting good rehabilitation postamputation are: young age, no ischemia and high levels of physical activity preoperatively [21]. It permits a personalized estimation of the prognosis and development of a rehabilitation concept. These analyses allows for risk-stratified patient pathways to be developed.

Lastly, the revised clinical guidelines for VA/DoD by Webster et al. propose a uniform multi-level rehabilitation program, in which cognitive assessment, psychosocial evaluation and functional recovery scale are required [22]. This method enables the incorporation of objective measures of therapy effect and enhances treatment planning. The recommendations indicate that all levels of the rehabilitation chain must include adjuvant measures, as determined by clinical markers and dialogue between patient and interdisciplinary team.

Conclusions. Rehabilitation following a lower limb amputation is a multifaceted treatment regarding the patient’s physical, psychological and social recovery. Early treatment, personalized physiotherapy schemes and interdisciplinary work are the key to improving therapeutic results. Active participation of the patient, support from the family and adjustment towards using prosthesis are important. New technologies, such as virtual rehabilitation and biomechanical monitoring, but also mirror therapy technologies may have a positive effect on quality of life and function. Data indicate that early prosthetic use, and ongoing rehabilitation, can decrease the morbidity and mortality of patients affected. Therefore, individualized and staged rehabilitation is essential for the successful re-integration of patients into normal activities.

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