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UNIVERSITATEA DE MEDICINĂ ȘI FARMACIE
„CAROL DAVILA”, BUCUREȘTI
ȘCOALA DOCTORALĂ
DOMENIUL MEDICINĂ/MEDICINĂ DENTARĂ/FARMACIE

*Assessment of the current situation of the management
of rehabilitation of persons with lower limb amputations
in Romania*

REZUMATUL TEZEI DE DOCTORAT

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ANUL 2023

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INTRODUCTION

Disability is inherent to the loss of an anatomical part, as this loss hinders the optimal functioning of the person as a whole. Compensating for the impaired functions and adapting to the new situation come with significant personal and socio-economic costs, while the capacity and level of activity and social participation are profoundly affected.

The loss of a lower limb abruptly reduces a person's ability to walk, having profound consequences both physically and psychologically, as well as socially. The ability to walk defines efficiency in both activities of daily life and socio-economic activities, since walking itself is a supporting activity for most self-care and participatory activities.

The rehabilitation of individuals with lower limb amputations is a complex and long-term endeavor that requires active involvement from both the multidisciplinary rehabilitation team (with training and experience in this niche field) and, necessarily, the patient, their family, and the entire community.

The general hypothesis this thesis is based on is as follows: a clear understanding of the specific situation regarding the management of lower limb amputation rehabilitation at the national level and the demonstration of the benefits of rehabilitation interventions applied at any time after prosthetic fitting can lead to identifying the needs related to the management of rehabilitation for these individuals and finding evidence-based solutions and proven methodological and strategic models to optimize the rehabilitation of individuals with lower limb amputation and prosthetic use.

The purpose of this doctoral thesis is to draw attention to the need for optimizing the management of rehabilitation for individuals with lower limb amputation and prosthetic use at the national level.

The objectives of this doctoral thesis are:

- To present the current state of rehabilitation for individuals with lower limb amputations, highlighting areas that require special attention, particularly the lack of a well-established national protocol developed by an interdisciplinary team involved in the entire treatment-recovery process of these individuals. The protocol should be implemented as early as possible and adequately supported by all decision-makers to achieve the best possible

results in terms of functional rehabilitation and socio-professional reintegration of individuals with lower limb amputations.

- To emphasize the benefits of rehabilitation interventions following lower limb prosthetic fitting, regardless of the time since amputation, with the aim of improving the level of independence and safety in daily activities.
- To formulate recommendations regarding the management of rehabilitation for individuals with lower limb amputation, aiming to optimize the outcomes and quality of life for these individuals, as well as potentially reducing healthcare costs by avoiding complications and ensuring continuity in efforts to improve their quality of life.

Based on my experiences in my field of work as an orthotist-prosthetist, I have started to gather information regarding the number of patients suffering from lower limb amputations. I have tried to discover the proportion of thigh amputations compared to lower leg amputations and understand why one is chosen over the other when there could be an optimal solution. Unfortunately, I have not found any national statistics or published works that explain this. The situation of amputated patients in Romania is not optimal.

Unfortunately, many patients are neglected, both due to an imperfect healthcare system and a lack of awareness about their rights and rehabilitation possibilities. Additionally, there is a lack of understanding and support from authorities. Another major problem I have encountered in my personal experience is the significant amount of time that passes between the moment of amputation and the completion of prosthetic fitting. This delay hampers the rehabilitation process, increases costs, and reduces the quality of outcomes.

I hope that through careful and accurate documentation, we will be able to bring attention to the needs of individuals with lower limb amputations and the communities in which they live. Only through local analysis and comparison with other countries can we explain why the current practices in rehabilitation and management of lower limb amputations and prosthetics in Romania need improvements. With this work, I wish to bring a positive change in how medical professionals in hospitals, authorities, and ultimately society as a whole approach amputations.

The thesis emphasizes the necessity of interdisciplinary collaboration among teams of orthopedic surgery, medical rehabilitation, social workers, and the specialized team in orthotics-prosthetics and prosthetic rehabilitation within prosthetic centers. In addition to this large

multidisciplinary team, specialists from medical fields addressing the patient's underlying medical condition (such as cardiovascular specialists, metabolic-endocrine specialists, and traumatologists) also play a crucial role.

The first part of this thesis, which presents the current situation in the field, includes two chapters: a description of the objectives and content of rehabilitation for individuals with lower limb amputations (Chapter 1) and an overview of the existing types of lower limb exoprostheses (Chapter 2).

The original contribution of this thesis consists of three chapters.

The first chapter of the original contribution is extensive (Chapter 3 of the thesis) and provides an overview of lower limb amputation rehabilitation at the national level, analyzed through a quadruple approach: a top-down approach, which includes national-level statistics; a bottom-up approach, which includes responses from individuals with lower limb exoprostheses to a questionnaire aimed at documenting their quality of life by describing determinant factors; a presentation of the activities of Theranova, a company founded and led by the doctoral candidate, which is involved in the production, import, and supply of exoprostheses and components; and a discussion on the relevance of high-quality lower limb prostheses for Paralympic performance.

The second chapter of the original contribution (Chapter 4 of the thesis) consists of presenting an original study aimed at highlighting the continued relevance of rehabilitation interventions after prosthetic fitting for individuals with lower limb exoprostheses. It also emphasizes the importance of using sensor-based devices for the rapid and objective quantification of functional parameters that are crucial in determining the level of safe activity and participation for individuals with lower limb exoprostheses. This study is the first of its kind conducted in our country.

The third chapter of the original contribution (Chapter 5 of the thesis) provides realistic and feasible recommendations for optimizing the management of rehabilitation for individuals with lower limb amputations.

This chapter is followed by the final conclusions and a brief presentation of the doctoral candidate's original contributions.

CURRENT STATE OF KNOWLEDGE

Chapter 1. REHABILITATION IN LOWER LIMB AMPUTATIONS

The aim of the personalized rehabilitation program is to achieve an optimal level of physical, mental, emotional, social, vocational, and economic efficiency. The ultimate goal is to ensure the highest possible quality of life given the circumstances.

Main objectives: proper care of the residual limb, management of symptoms, early mobilization with the maximization of functional independence, psychological support, informing and educating the patient about health condition management strategies, functioning, activities, and participation, preservation/regaining of mobility, muscle strength, balance, management of the exoprosthesis, locomotion, and activities that require bipedal stance and walking, successful reintegration into the community, regaining independence in daily life activities, and socio-professional reintegration.

Up to 9 stages of assessment and intervention can be defined, each with specific therapeutic objectives. Throughout the entire rehabilitation process, communication and coordination are essential within the multidisciplinary rehabilitation team as well as with the patient and their family. The entire rehabilitation program must be personalized and dynamically adapted based on the patient's personal goals, health condition, level of amputation, functional deficits, functional prognosis, feasible requirements for returning to previous professional or sports activities, and other personal and environmental factors.

Amputations at the foot level will inevitably and irreversibly affect the functions of these muscle groups, resulting in deformities in the foot's anatomy with alignment and functional impairments.

Chapter 2. LOWER LIMB EXOPROSTHESES

The origin of prostheses is lost in the mists of time, and it is difficult to determine where and when the first prosthesis was made. Currently, the oldest evidence of a prosthesis is represented by a wooden hallux, attached to the foot with the help of leather laces, found on a female mummy dating back to 1000 BC in Egypt.

Different types of lower limb exoprostheses have been created in response to real needs regarding the optimization of functioning for individuals with lower limb amputations under various aspects, to improve the level of activity and participation.

Personalization of the lower limb exoprosthesis is necessary based on functional parameters and other personal, environmental, and activity-related factors. At the same time, the exoprosthesis needs to be adapted to meet the requirements of different stages of rehabilitation and changes in the beneficiary's activity. This activity requires constant communication and ongoing support from the rehabilitation team and the prosthetic device provider for the user of the lower limb exoprosthesis.

II. PERSONAL CONTRIBUTION

Chapter 3. MANAGEMENT OF LOWER LIMB AMPUTATION REHABILITATION IN ROMANIA

3.1. TOP-DOWN APPROACH - AMPUTATION STATISTICS ACCORDING TO DATA PROVIDED BY THE NATIONAL INSTITUTE OF PUBLIC HEALTH (NATIONAL SCHOOL OF PUBLIC HEALTH, MANAGEMENT, AND PROFESSIONAL DEVELOPMENT)

The objective of this study is to present the situation of individuals with lower limb amputations in our country.

Statistical data analysis has been conducted regarding the number of different types of amputations, their causes, distribution within the territory of our country, along with the analysis of the patient's journey until achieving functional independence and optimal social participation.

The management of lower limb prosthetic rehabilitation requires optimization. The improvements should address both the composition and competencies of the prosthetic rehabilitation team members, the flow of rehabilitation, which should be free of discontinuities and have a personalized duration, the reduction of bureaucratic burden on the patient, the

reduction of rehabilitation costs incurred by the patient (including prosthetic costs), the inclusion of the prosthetic service and prosthetic rehabilitation itself in the workflow, as well as emphasizing prevention and providing medical education and specific training to patients.

3.2. BOTTOM-UP APPROACH: QUESTIONNAIRE FOR INDIVIDUALS WITH LOWER LIMB AMPUTATIONS.

It is necessary and relevant to contextualize the healthcare provided to individuals with lower limb amputation in order to understand what happens to the patient from hospitalization to the moment they receive a prosthesis.

The study allows for reflection on the care of amputated individuals from a bioethical perspective, considering that studies on this topic focus on the characteristics of the interested parties, the care provided by professionals, and the experience of amputated individuals. In other words, in Romania, there are no previous studies available that analyze the bioethical aspects of the healthcare process for individuals with amputations.

Therefore, the bioethics of protection and intervention was considered to be a productive possibility for reflecting on the care provided to individuals with amputations. It is highlighted that both contribute to a detailed argumentation on various and different subsidies resulting from public health policies, which can influence the quality of care provision and assist individuals, whether or not they have undergone amputation, in reflecting on rehabilitation and their new living condition.

Furthermore, over the course of nearly twelve years since the respective amputations, a precarious situation regarding the physical, social, and economic independence of patients has been evident. In short, the results obtained from these qualitative research studies do not allow for generalizations but raise questions such as: is the right to socio-professional integration guaranteed for these individuals? If not, is the cause the lack of knowledge among individuals with amputations and/or the medical team, or the disorganization present in the health care process? Studies focusing on the activities of individuals with amputations are necessary, observing whether they adapt to their new life conditions and develop a quality life or not. As proven, the activities of professionals during the care process of individuals with disabilities are

relevant for their adaptation to this "new life." Based on the perspectives of these professionals, a care network should be created for individuals with these disabilities.

3.3. THERANOVA EXPERIENCE

The Theranova Prosthetics and Orthotics Center was born out of the desire to provide much-needed assistance to individuals with special needs, which at that time was missing. Theranova represents the combination of two key words: **Thera**, derived from *therapy*, and **nova**, meaning *new*.

A competent team dedicated to individuals requiring rehabilitation after amputation, along with proper information and support, achieves successful prosthetic rehabilitation by designing and constructing optimal prostheses and providing individualized guidance throughout the rehabilitation program, while continuously monitoring the individual's functional progress, overcoming inherent barriers whenever possible.

Establishing and maintaining a truly beneficial amputee rehabilitation center is a permanent and demanding task that requires constant information updating, as well as the creation and maintenance of a network of business partners, medical professionals, social partners, and decision-makers and funders.

3.4. THE IMPORTANCE OF HIGH-QUALITY PROSTHETIC DEVICES IN ROMANIAN PARALYMPIC SPORTS

The objective of this study is to present the practical relevance of optimal construction and utilization of a lower limb prosthesis in enhancing the performance prospects of Paralympic athletes with lower limb amputations.

A special category of individuals engaged in sports activities are those who have experienced limb loss or amputation, but the majority are highly active individuals who were involved in sports even before their amputation, and they continue to compete in para-sports. Working in the field of prosthetics and having the opportunity to collaborate with such motivated individuals, I have sought to highlight the importance of using a prosthetic device in such activities.

To ensure an optimal level of performance in vocational activities, careful customization of the lower limb prosthesis is necessary, along with the use of high-quality materials and components that provide the necessary functionality, as well as reliability and safety during use.

Both the quality and specificity of the prosthesis, as well as physical conditioning (including promoting tissue trophicity and overall health of all body tissues, systems, and organs) and psychological well-being, along with cost-effective strategies for engaging in the respective sports activities, ensure the competitiveness of athletes with lower limb amputations and their successful participation in international Paralympic competitions.

Chapter 4. REHABILITATION AFTER LOWER LIMB PROSTHESIS - THE IMPORTANCE OF CONTINUITY

In the case of individuals who have undergone lower limb amputation, mobility is severely reduced post-amputation, and the quality of life is compromised without appropriate and timely prosthetic fitting, psychological support, and a supervised rehabilitation program provided by competent individuals, applied consistently, personalized, and adapted over an extended period. In many parts of the world, the capacity of healthcare systems to provide necessary rehabilitation services is severely limited or nonexistent. Studies indicate that 92% of the burden associated with medical conditions is linked to conditions requiring rehabilitation interventions, with a significant correlation between the need for rehabilitation services and the lack of specialized personnel.

The aim of this study was to emphasize the importance of implementing monitored physical therapy programs and providing objective feedback to the beneficiaries, regardless of the time since amputation/prosthesis or the demographic characteristics of the beneficiary.

The objectives of the study included:

- Demonstrating the relevance of providing a conducive framework and logistic and motivational support for the continuous rehabilitation of individuals with lower limb exoprosthesis.
- Testing two sensor-based tools for assessing gait and balance capacity to evaluate the effectiveness of rehabilitation programs for individuals with lower limb amputation and

exoprostheses. These tools can provide a rapid, reproducible, and quantifiable method for assessing important parameters of locomotor function and safety in bipedal statics and locomotion for individuals with lower limb exoprostheses.

- Highlighting the need for continuous support provided by the specialized orthotics-prosthetics professional and the prosthetic rehabilitation specialist to achieve ongoing improvement in the quality of gait and balance for individuals with lower limb exoprostheses, as well as the benefits of personalized rehabilitation interventions.

The instrumental analysis of gait using wearable devices brings the advantage of quantifying parameters and visualizing functional behavior in real-life conditions, thereby facilitating and providing greater precision in the evaluation process conducted by physiotherapists. The collected data can be stored and compared before and after the intervention, allowing for the adaptation of the rehabilitation program and the assessment of intervention effectiveness.

The use of instrumented gait analysis methods with wearable inertial sensor devices can bring benefits to prosthetic rehabilitation, including monitoring functional progress at home during long-term rehabilitation required for individuals with lower limb amputation.

Regardless of the individual's age, time since amputation, body mass, or gender, rehabilitation interventions can lead to functional gains that reflect in the individual's level of activity and participation, indicating the need for a reevaluation of the rehabilitation strategy for individuals with lower limb amputation. This re-evaluation should include monitoring and reassessment within rehabilitation services, as well as closer collaboration between rehabilitation teams in the healthcare system and prosthetic rehabilitation specialists in prosthetic centers.

Chapter 5. RECOMMENDATIONS FOR OPTIMIZING MEDICAL REHABILITATION AND GENERAL MANAGEMENT OF INDIVIDUALS WITH LOWER LIMB AMPUTATIONS

The ultimate goal of this doctoral thesis is to propose solutions that can bring improvements to the applied system in our country regarding the management of individuals

with amputations and the process of prosthetic fitting and socio-professional reintegration of the individual with an amputation.

Solving this issue requires interdisciplinary collaboration among all individuals and specialists involved in this process, with a concrete delineation of the steps to be followed from the moment the patient comes into contact with the attending physician until the patient becomes completely independent and reintegrated into socio-professional and economic life.

An interdisciplinary approach is mandatory, without highlighting the lesser or greater importance of individuals within this group. It is important that each specialist can contribute at the most appropriate moment, providing the best guidance and acting based on the best knowledge they possess to achieve the desired final outcome, namely patient satisfaction and rehabilitation.

Each specialist will need to act within their own specialty, but knowledge of the needs and requirements of another field will help in making important decisions. For example, if the surgeon is aware of the technical possibilities offered by different types of prostheses, it will be much easier to decide on an optimal level for the lower limb amputation. Additionally, they can present the patient with the various advantages or disadvantages of an amputation level.

The prosthetic protocol should begin during the in-hospital period. If possible, the orthopedic technician should be consulted to determine the optimal length of the amputation stump. If this is not possible, as a general rule, it can be considered that an optimal stump length for transtibial cases is in the middle third of the leg. Long stumps should be avoided as much as possible, as although they adhere to the principle of preserving as much of the anatomical limb as possible, they do not offer the best chances for prosthetic fitting by limiting the prosthetic components that can be used by the patient to achieve an efficient and high-performing prosthesis. The implementation and execution of a rehabilitation program through physiotherapy and physical agents therapy is absolutely necessary within the prosthetic protocol. The physiotherapy program should ideally begin in the preoperative period, resumed as early as possible immediately after the amputation, and continued after acquiring the prosthesis, at which point the decisive role will be the recovery of walking and learning to use the prosthesis. The minimum mandatory duration of the post-prosthetic rehabilitation program should be two weeks, with daily sessions of 45-50 minutes each.

The rehabilitation medical team should have the optimal composition (including, alongside the specialist rehabilitation physician, nurses, occupational therapists, physiotherapists specialized in prosthetic rehabilitation, clinical psychologist, dietitian, prosthetist-orthotist, and social worker), and it would be beneficial to establish multidisciplinary rehabilitation centers. Another aspect to consider is the position of physiotherapists within the medical teams. Apart from rehabilitation departments, there are currently physiotherapists (with various competencies) employed in neurology, orthopedics, and even surgery and intensive care units, alongside independently practicing physiotherapists. Since neither the surgeons nor the orthopedic specialists have expertise in rehabilitation, these physiotherapists likely work independently. All these professionals should receive training to properly meet the requirements of each patient and should be coordinated by the physical medicine and rehabilitation physician for efficiency and safety.

The education of professionals should be a priority in order to acquire new knowledge and skills, including the ability to educate the patient about their medical condition and the benefits of prevention and a continuous, personalized, and dynamically adapted rehabilitation program based on real needs regarding the included interventions, intensity, and complexity.

The training of prosthetic and orthotic specialists is required to provide quality services in the preparation, construction, and adaptation of optimal exoprostheses for each stage of the rehabilitation process.

A decisive role in the prosthetic process is played by the financial factor. As mentioned earlier, many patients cannot afford more advanced prostheses and are limited to the financial resources provided by the public health insurance system, which only allows for the creation of simpler prostheses.

Currently, Romania has a rigid and uniform reimbursement and assessment system for the needs of amputees, without considering any criteria other than the anatomical level of amputation. The level of activity, age, profession, and personal needs are not taken into account when recommending the appropriate prosthetic equipment. All patients receive the same amount of money to obtain a prosthesis, which is only sufficient to cover the cost of a basic prosthesis.

A solution has recently been introduced to enhance comfort following the request made by me and members of the APPIFDM association. The result was the reimbursement of a silicone liner every two years, which significantly contributes to the patient's comfort within the

prosthetic socket and provides safety in the suspension of the residual limb within the prosthesis through a quick-release coupling with a pin.

In various developed healthcare systems, there has been a need to categorize patients in need of external prostheses. This categorization serves two purposes: firstly, to enable the payment system to provide differentiated financial support based on the type of prosthesis, and secondly, to provide clear recommendations by specialized personnel regarding the appropriate medical device that meets the needs and capabilities of the prosthesis wearer, allowing them to maximize the use of the medical device.

This evaluation system is based on the categorization of patients, specifically their potential to correctly use a prosthesis in the rehabilitation process, on a scale from 0 to 4. Each category corresponds to a specific prosthetic equipment that can be recommended, ensuring that the "medical necessity" meets the immediate needs of the patient and enables their unrestricted development in the long term. This classification into different levels of activity is known as the "**K Levels**".

Efforts must be made to effectively ensure that the rights of people with disabilities and recommendations for best practices in the field of rehabilitation are implemented in real life. Additionally, there should be endeavors to prioritize disability prevention (whether primary, secondary, or tertiary) with beneficial effects at both the individual and community levels. Pre-rehabilitation should become part of care programs for individuals who are about to undergo amputation, as well as for all individuals requiring healthcare for medical conditions that can benefit from lifestyle modifications.

CONCLUSIONS AND PERSONAL CONTRIBUTIONS

This study intended to present the situation of rehabilitation for individuals with lower limb amputations, highlighting key areas that require special attention. Specifically, the lack of a well-established national protocol developed by an interdisciplinary team involved throughout the entire treatment-recovery process was emphasized. It is crucial to implement such a protocol as early as possible and ensure adequate support from all relevant decision makers in order to achieve the best outcomes in terms of functional rehabilitation and socio-professional

reintegration of individuals with lower limb amputations. Furthermore, the study sought to emphasize the benefits of rehabilitation interventions following lower limb prosthetic fitting, regardless of the time since amputation, in order to enhance independence and safety in daily activities. Recommendations were also formulated regarding the management of rehabilitation for individuals with lower limb amputations to optimize outcomes and quality of life, along with the potential reduction of healthcare costs by preventing complications and ensuring continuity of efforts to improve quality of life.

GENERAL CONCLUSIONS

The disability associated with lower limb amputation is multifaceted, impacting individuals both physically and psychologically. The lower limb exoprosthesis can serve as an assistive tool that compensates for a significant portion of personal structural and functional deficits if the rehabilitation process is initiated early and efficiently managed by a multidisciplinary rehabilitation team, which should include the prosthetist-orthotist and a specialized physiotherapist in prosthetic rehabilitation.

Customization of the lower limb exoprosthesis is necessary based on functional parameters and other personal, environmental, and activity-related factors. Simultaneously, the adaptation of the exoprosthesis is needed to meet the requirements of different stages of rehabilitation and the changes in the individual's activities. This activity requires ongoing communication and continuous support from the rehabilitation team and the prosthetic device provider to ensure the optimal fit and function of the lower limb exoprosthesis for the user.

Management of rehabilitation after lower limb amputation requires optimization. Improvements should address both the composition and competencies of the prosthetic rehabilitation team, the flow of rehabilitation, which should be free of discontinuities and have personalized duration, reducing the bureaucratic burden on the patient, reducing rehabilitation costs for the patient (including prosthetic costs), incorporating prosthetic services and prosthetic rehabilitation into the flow, as well as emphasizing prevention and providing medical education and specific training for patients.

Presenting the situation of individuals with lower limb prostheses from various perspectives proves productive for reflecting on the care provided to amputees, highlighting many important aspects regarding prosthetic rehabilitation in our country.

There is a precarious social and economic situation for these patients. In short, the results obtained from these qualitative research studies do not allow for generalizations but raise questions: Is the right to socio-professional integration guaranteed for these individuals? If not, is the cause a lack of knowledge among amputees and/or the medical team, or is it the disorganization present in the healthcare process, along with underfunding?

As it turns out, the activities of professionals during the care process for individuals with disabilities are relevant in helping them adjust to their "new life." Based on the perspective of these professionals, a care network should be established to provide care for individuals with disabilities.

A competent team dedicated to individuals in need of prosthetic rehabilitation, along with appropriate information and support, through the design and construction of optimal prostheses and personalized management of the prosthetic rehabilitation program, as well as continuous monitoring of the individual's functional progress, ensures the success of prosthetic rehabilitation, overcoming inherent barriers to the extent possible.

Creating and supporting a truly beneficial prosthetic rehabilitation center is a challenging and ongoing task that requires staying up to date with information, as well as establishing and maintaining a network of business partners, medical partners, social partners, and decision-makers and funders.

To ensure an optimal level of performance in vocational activities, careful personalization of the lower limb exoprosthesis is necessary, along with the use of high-quality materials and components that provide the required functionality, reliability, and safety.

Both the quality and specificity of the prosthesis, as well as physical conditioning (including promoting tissue trophicity and overall health of all body tissues, systems, and organs) and psychological factors, along with cost-effective strategies for sports performance, ensure the competitiveness of athletes with lower limb amputations and their successful participation in international Paralympic competitions.

The use of instrumented gait analysis methods with wearable miniature devices can bring benefits to prosthetic rehabilitation, including monitoring functional progress at home, during the long-term rehabilitation required for individuals with lower limb amputations.

Regardless of age, time since amputation, body mass, or gender, rehabilitation interventions can yield functional gains that translate into the individual's level of activity and participation. This may indicate a need for re-evaluation of the rehabilitation strategies for individuals with lower limb amputations, including monitoring and reassessment within rehabilitation services, as well as closer collaboration between rehabilitation teams in the healthcare system and prosthetic rehabilitation specialists in prosthetic centers.

PERSONAL CONTRIBUTIONS

The personal contributions of the doctoral candidate regarding the chosen topic consist of:

- Synthesizing the situation of prosthetic rehabilitation management of the lower limb in our country through a multidimensional approach: top-down (Subchapter 3.1), bottom-up (Subchapter 3.2), and the perspective of the prosthetics specialist (Subchapter 3.3).
- Conducting three original studies: one based on a questionnaire (Subchapter 3.2), the second based on semi-structured interviews with paralympic athletes benefiting of prosthetics from Theranova (Subchapter 3.4), and the third using two wearable sensor based evaluation tools (chapter 4). All three studies are the first of their kind in the country, focusing on the target population.
- Synthesizing recommendations regarding the practice of prosthetic rehabilitation of the lower limb and facilitating administrative aspects (Chapter 5).
- Publishing two original articles in journals indexed in international databases:
 - *"The importance of prosthetic devices in sport activities for Romanian amputees who compete in Paralympic competitions"*. **Jacobus Hercules Du Plessis**, Mihai Berteanu. Sports Medicine (2020), vol. XVI no 1, 3197-3204 (Subchapter 3.4). Romanian Sport Medicine Journal is indexed in databases: QT 261-Sports Medicine Bookmarks, ProQuest, CNCSIS, Romania, EBSCO SPORT Discuss with Full Text, Open Academic Journals Index (OAJI), ERIH PLUS.

Article links:

<https://www.medicinasportiva.ro/SRoMS/english/Journal/No.53/prosthetic-devices-sport-amputees-Paralympic-competitions.html> și

<https://web.p.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=18410162&AN=143836980&h=blpe%2fToS5fVxWjMEUxo2J4io9s1idaN9zxJzs0nrX2dsAetbVVO06Vl6VpMGB%2bxJgWI4M1KRjviWA67jYRZK0g%3d%3d&crl=c&resultNs=AdminWebAuth&resultLocal=ErrCrlNotAuth&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26authtype%3dcrawler%26jrnl%3d18410162%26AN%3d143836980>

- **„Prosthetics and rehabilitation in lower limb amputees”. Jacobus Hercules Du Plessis, Mihai Berteanu.** Health, Sports & Rehabilitation Medicine. Vol. 21, no. 3, July- September 2020, 192–198. <https://doi.org/10.26659/10.26659/pm3.2020.21.3.192> (Subchapter 3.2.) Health, Sports & Rehabilitation Medicine is indexed in databases: EBSCO, Index Copernicus, DOAJ, CiteFactor, Crossref.

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<https://jhsrm.org/health-sports-rehabilitation-medicine-vol-20-no-3-july-september-2020/prosthetics-and-rehabilitation-in-lower-limb-amputees/> și

<https://web.s.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=26682303&AN=147349297&h=tAPQJ7bgdfkNfb9pLP3q0melB1%2fAIDOUUXFQJGgSI8eYEs8yUKihmTHnQAPNsQ62Ybi04pJtUzOBfHSI86ORgA%3d%3d&crl=c&resultNs=AdminWebAuth&resultLocal=ErrCrlNotAuth&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26authtype%3dcrawler%26jrnl%3d26682303%26AN%3d147349297>

The aim of this doctoral thesis was to present both the deficiencies in the management of lower limb prosthetic rehabilitation and the positive effects of well-coordinated management throughout the rehabilitation process. By implementing a timely and comprehensive recovery program involving all specialized members of the interdisciplinary team, the desired outcome of improving the quality of life for individuals with lower limb amputations can be achieved. This improvement includes increased capacity and performance in activities involving walking,

maintaining or enhancing levels of participation, and facilitating the socio-professional reintegration of individuals with lower limb amputations.

An ecosystemic approach is needed, where bottom-up pressure is stimulated concurrently with horizontal and top-down pressures, both domestically and internationally, until the sustainability of the new strategy is achieved. This requires the establishment of a stable culture based on experience and multidimensional education, both within the formal education system and in the civil society.

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