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A Case Report: Diabetic Amputee

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A CASE REPORT: DIABETIC AMPUTEE

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(Graduate School Advisor)

(Chairperson, Physical Therapy)

PERMISSION

Title Diabetic Amputee

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ACKNOWLEDGMENTS

This project is dedicated to my parents. I am a product of their teachings and way of life. They taught me drive, passion, hard work, respect, and unconditional love. I owe them everything.

ABSTRACT

Background and Purpose: The purpose of this case study is to present the reader with a detailed description of the physical therapy provided for a diabetic lower extremity amputee. As the number of amputations across America steadily increase, there is an elevated importance of understanding the prevalence, causes, and reasons for amputations and which interventions are most effective in increasing a patient's quality of life. **Case Description**: The patient is a 77 year old male with significant past medical history of type I diabetes mellitus, hypertension, and osteoarthritis. This patient has significant gross muscle weakness in both his upper and lower extremities. Following his amputation proper prosthetic fitting could not be completed secondary to his significant weakness. Physical therapy intervention focused on functional exercises to help this patient return home safely with complete independence. **Discussion**: Most amputees receive a prosthetic shortly after surgery; however, a small amount of new amputees do not have the strength, stamina, and independence to begin functioning with a prosthetic immediately after surgery. Further research needs to be conducted focusing on which interventions and treatment strategies are most effective for patients that are not able to be fit with a prosthetic following surgery.

Chapter I

BACKGROUND AND PURPOSE

There are certain events that can dramatically change a person's life and physical function. Lower extremity amputations may be classified as one of the major events. A lower extremity amputation can be categorized in two ways: above the knee amputations (AKA) or below the knee amputations (BKA). Below the knee amputations provide the person with more balance and stability, strength, and mobility following surgery[1]; whereas an above the knee amputation makes recovery and return to normal everyday functioning much more difficult.[1] A study by Nolan[2] found that hip extensor strength was significantly greater in BKA patients as compared to AKA patients. Trauma, congenital deformities, and diabetic neuropathy could be some possible causes of lower extremity amputation.

Moxey et al [3] found in a retrospective study that the incidence of lower extremity amputations across countries vary; however, the number of amputations being performed have increased. Li et al [4] found that diabetes is currently the leading cause of non traumatic lower extremity amputations. With the rising obesity rates and high fat diet consumption in America, the prevalence of diabetes is also continually growing. Roughly 9.6% of age-adjusted adults in America have diabetes with a projected 9.9% growth by the year 2035[5]. According to the American

Diabetes Association website, roughly 79 million people are considered pre diabetic, and 25.8 million children and adults have diabetes[8]. Diabetes mellitus can create multiple difficulties and complications for the person involved. One complication of diabetes that may present the most difficulty is peripheral neuropathy. In the USA, roughly 82% of all vascular related amputations are associated with diabetes[6].

Literature supports a clear connection between diabetes and ulcer formation. Boulton et al[8] states that 15% of diabetic patients will have some form of ulcer formation during their lifetime[7]. Futhermore, Boulton et al.[7] found that roughly every 30 seconds a amputated due to diabetes. Venous ulcers are the prime cause of amputations in diabetic patients. Therefore, healthcare professionals need to be aware of proper wound care procedures and practice to help prevent future complications or infections of the wounds. Diabetes, wound care, and glucose control create a large amount of health care dollars to be spent.

The health care costs that accompany an amputation should be noticed. The health care cost of diabetes in the year 2013 was 263.2 billion dollars[5]. Also, the total mean costs following an amputation were 26% higher in diabetic patients as compared to those without diabetes[8]. This expresses a direct relationship between diabetes and expenditures; as the number of diabetics increase, so do the healthcare costs. According to Sen et al[9] 6.5 million people are affected by chronic wounds wtih an excess of 25 billion dollars being spent annually to treat those wounds. This may be related to the increased prevalence of diabetes and obesity in the United States. Therefore, it may be beneficial to focus on interventions to lower these health care costs and improve quality of life of patients living with chronic wounds.

Another influence on health care cost is falls and fall prevention. One in five patients with lower limb amputation will likely experience one fall during inpatient rehabilitation, with 18% sustaining injury[10]. Not only does an elderly patient need adequate strength to function, they also need adequate balance. Balance can be a great predictor of how someone will be able to function independently at home with physical therapy utilized in improving balance and promoting fall prevention. Balance is a modifiable risk factor that can be improved with the use of physical therapy[11]. Balance is a multi-facet system combining the vestibular, musculoskeletal, and neuromuscular systems. Without all systems working in unison, potential problems and possible falls may arise.

A significant loss in standing and seated balance is noted following a lower extremity amputation. Research identifies that seated balance is compromised following a lower extremity amputation in anterior, posterior, and lateral directions[12]. Seated and standing balance needs to be progressed accordingly to assist the patient in returning to his or her prior level of function. Balance is one of the main predictors of fall prevention; therefore, improving balance may ultimately reduce a patient's likelihood of falling once ambulation is initiated.

The purpose of this case study is to present information regarding a patient with type I diabetes mellitus who had difficulty returning to his prior level of function following a below knee amputation. This case report describes in detail the road to recovery for an amputee with impaireed strength, balance, and mobility. It is intended for the readers to acknowledge and appreciate the time intensive and patient focused plan of care that needs to be instituted for a patient with this diagnosis. Some people assume that

following an amputation the patients will automatically receive and utilize a prosthetic device for ambulation, but that's not always the case. Some patients lack the strength, endurance, and healing properties that make it impossible to return back to their normal life.

Chapter II

CASE DESCRIPTION

Subject History: The patient was a 77 year-old male with a significant history of osteoarthritis, type I diabetes mellitus, and hypertension. He was treated at a sub acute rehabilitation facility following a 4 day hospital stay following his amputation. This particular patient was a healthy weight and had no significant cardiovascular pathologies. Neuropathy was present secondary to his diabetic condition A pressure sore had developed on his right foot, which eventually became infected with methicillin-resistant staphylococcus aureus (MRSA). To prevent further destruction and spread of infection, physicians conducted a right below knee amputation.

During the initial evaluation only, contact isolation was utilized due to an MRSA infection. During most treatment sessions, the patient was accompanied by his son and/or daughter. The patient had significant family support throughout his treatment. The family was involved with his treatment plan and were educated on different treatments that were to be completed. Overall, the patient was driven and focused to return back to his prior level of function. He was an active man prior to his amputation and desired to remain active in the future.

SYSTEMS REVIEW

Cardiopulmonary: Patient's oxygen saturation at the time of evaluation equaled 96% with a blood pressure 131/88. Therapy noted excessive breathing with functional movements with a low conditioning level assessed. Patient's hypertension was controlled through the use of prescribed medication.

Neuromuscular: Therapy was well aware of this patient's neuropathy. Sensory system was compromised secondary to diabetic condition. Patient had difficulty generating strong muscle force during manual muscle testing.

Musculoskeletal: Patient had multiple strength deficits. His manual muscle grades were as follows: Upper extremity strength equaled 4/5 throughout and lower extremity strength equaled 3+/5. Due to overall weakness the patient was unable to perform ADLs independently.

Integumentary: In addition to his BKA, the medical staff was treating a left lateral heel ulcer, left 2nd digit necrosis, and a large sacral ulcer. Initial prosthetic limb fitting did not occur following surgery due to impaired healing of amputation site.

Examination: Following the amputation, the patient presented with significant weakness during all functional movements. Initially, the patient needed a hoyer lift with maximal assist of 2 health care providers to transfer from his wheelchair to bed, toilet, and other surfaces. In addition, bed mobility was completed with maximal assist of one to allow sitting to transfer movement. The patient displayed difficulty with static sitting in his wheelchair and was unable to static sit without a back rest for an extended period of time. The patient displayed full pain free active range of motion in both his lower and

upper extremities. Gross motor strength was 4/5 throughout his upper body and 3+/5 for his lower extremities. Other than his pain generated from osteoarthritis, the patient reported zero complaints of peripheral joint pain. A functional assessment was not completed at his initial evaluation. According to Brinkley et al[7], the Lower Extremity Functional Scale (LEFS) is the premier tool to use for assessing functional impairments in patients with a wide variety of lower extremity injuries. LEFS is a one page questionnaire relating to the patients lower extremity function and can be completed in a short period of time[14]. The LEFS has superior reliability to the short form 36 evaluation and is an assessment that a health care professional can use with confidence[14]. Since the patient's activity level was extremely low, his LEFS score would have most likely been limited. The LEFS would have been beneficial to implement into his future plan of care.

Evaluation: Following his examination, therapy decided to direct its focus toward balance, environmental awareness, proprioception, and strength. These interventions would be useful in order for the patient to return home safely. This patient needed care in many different aspects including skin integrity, blood sugar levels, strength, balance, coordination, and all functional movement.

Diagnosis: According to the Guide to PT Practice, this patient falls under the 4J practice pattern. The patient may have impaired motor function, muscle performance, range of motion, gait, locomotion, and balance associated with an amputation.

Prognosis: According to the Guide to PT Practice, the number of visits for a patient of this pathology can range from 15-45. Because of his significant past medical

history of DM type 1, osteoarthritis, hypertension and existing pressure sores, it was difficult to predict how many visits would be needed.

Nagi Disablement Model: The Nagi Disablement Model was used to help categorize this patient's pathology, impairments, functional limitations, and disabilities. The patient has diabetes mellitus type 1 as his main pathology. From the diabetes, he developed a pressure sore which became infected with MRSA and led to a below knee amputation. Following BKA, he had difficulty transferring in and out of bed independently, to and from bathroom or ambulation independently. These multiple functional limitations have caused him to completely change his way of life. He can no longer work and help his family financially, and his duties as a grandpa, father, and husband have drastically changed. These functional limitations and disabilities have caused a decrease in his quality of life.

Problem List

1. Decreased independence
2. Decreased strength
3. Increased pain
4. Decreased balance
5. Impaired wound healing and wound closure

Goals: The patient's primary goal was to be able to single leg stand for five minutes to allow the prosthetist to fit him with a prosthetic leg. Furthermore, he stated how he would like to become more independent and not rely so much on others. From the

examination, evaluation, and professional judgment, short and long term goals were formulated.

The goals were:

Short Term Goals (to be completed in 3 weeks)

Following physical therapy intervention:

1. Patient will be able to increase strength in UEs to 4/5 strength to self propel himself in w/c 200 feet on various surfaces to allow safe and efficient wheelchair mobility in and out of his room.
2. Patient's seated balance will be able to display independent and safe bed mobility with use of handrails to help prepare patient for a safe return to home.
3. Patient will be able to decrease his pain to 2 out of 10 with functional movement to help him transfer to his bed and toilet.

Long Term Goals (to be completed in 8 weeks)

Following physical therapy intervention:

1. Patient will be able increase his LE strength to 4/5 to single leg stand in parallel bars for 5 min. with minimal UE support for the prosthetist to feel confident in fitting the patient with a prosthesis.
2. Patient will be able to become independent with all transfers for 5/5 trials to allow the patient to safely complete w/c to bed and w/c to toilet transfers with sliding board so he can feel fully capable when returning home.

CHAPTER III

INTERVENTIONS

Education: Both individual and family education was a significant aspect of physical therapy intervention. Many strategies were identified to assist in improved function. For example, transfer training with a slide board from his wheelchair to his bed was frequently applied. He would position himself perfectly next to his bed, but he would always lack the coordination and muscle memory to remove his arm rest and leg rest from his wheelchair. Many attempts and failures were needed; however, he finally understood the concept and was able to independently replicate it from that point forward. Family education was very important and consisted of patient repositioning, transfer techniques, and proper home exercise program completion.

According to Boulton[13], education plays a pivotal role in a patient's likelihood of recurring foot ulcers. Proper repositioning techniques were taught to the patient to help prevent any further integumentary injury. Patient and family were repeatedly instructed to reposition in order to remove pressure from his bony prominent areas.

Education is also a crucial component for teaching proper bed mobility. Bed mobility is an everyday activity; however, there are some patients that have difficulty with this activity of daily living. instructing the patient how to safely

transfer while using bed rails or other bed modifications is important. Bed design modifications should be utilized to assist in the ease of trunk flexion and to conserve patient energy for later therapeutic exercise[14].

Strengthening: Once the amputation had been completed, it was highly recommended that the patient participate in a strengthening program to improve functional outcomes[2]. In order to promote strengthening, seated LE exercises such as ankle pumps, heel slides, knees to chest, ball squeezes, toe raises, gluteal squeezes, and hamstring curls with a theraband were utilized. These exercises were completed at least once daily to maintain and improve his lower extremity strength. Exercises were progressed from antigravity resistance to 3 pound ankle weights. Also, exercise bands were instituted in the patient's program to further increase his strength.

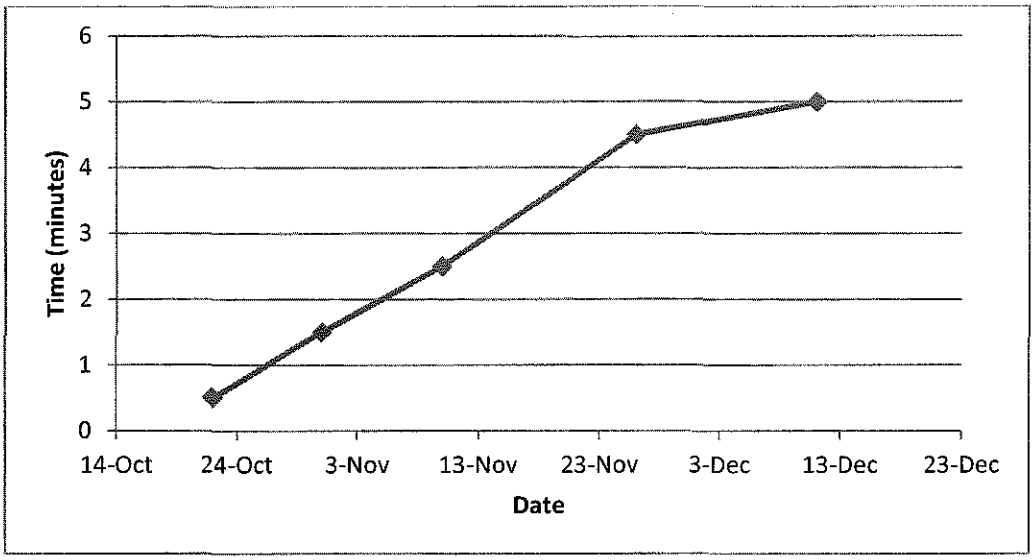
The patient's initial abdominal strength was a 2/5. Some examples of core exercises were catching a ball outside base of support (BOS) while seated on a plinth, rhythmic stabilization while seated, dynamic reversals, and reaching outside BOS to stack cones. Supine to sit transfers were utilized once the patient's strength increases.

Upper extremity (UE) strengthening included independent wheelchair ambulation on different surfaces to assist in strengthening the triceps and anterior chain musculature. In addition, rhomboid, middle trapezius, and posterior deltoid strengthening were completed utilizing theraband to improve scapulothoracic stabilization. Occupational therapy assisted primarily with the patient's UE strength.

Transfer Training: Transfer training included sit to and from stand, wheelchair to and from bed, bed mobility, and wheelchair to and from toilet transfers. These functional exercises appeared to be the best activities to practice because he would have to perform them once he returned home. Since the patient and his family stressed the importance of feeling safe, an emphasis was placed on providing and perfecting the sit to stand, wheelchair to bed, bed mobility and wheelchair to toilet transfers.

Balance: The main balance and strengthening activity conducted was static standing in the parallel bars with minimal upper extremity support. The patient performed a sit to stand and positioned his hands on the parallel bars. Once he was standing upright with good posture the timing would begin. Table 1 illustrates the static standing progress made over the course of therapy.

Table 1. Single leg stance progression over time



The single leg standing was a precursor for the patient to complete prior to being fit for a prosthetic. The prosthetist required that the patient be able to stand for 5 minutes

with minimal upper extremity support before being fitted with a prosthetic limb. Over the course of therapy, there was a direct correlation between the patient's functional movements, and the amount of time he could single leg stand. The longer he could single leg stand, the more independent he became with toilet transfers, bed mobility, and sit to stand procedures. The single leg stand gave the patient the increased strength, stamina, and coordination needed for his functional movements throughout the day.

The Berg Balance Scale was not used with this patient, because he was not fit with a prosthetic. Nevertheless, the berg balance scale would be a premier balance assessment to use for an amputee patient. The berg balance scale has excellent interrater and intrarater reliability; therefore, this balance test should be used to properly assess an amputees skill with multiple balance activities[15].

The patient's confidence with his balance improved over the course of therapy. A study conducted by Miller et al.[16] found that higher confidence in balance shows improvements in mobility capability and social interactions. As the patient became more confident and comfortable with his balance and exercises, the easier it became for him to perform his functional movements and his overall attitude improved.

Chapter IV

OUTCOMES

Pressure Sores: Following physical therapy intervention, the patient had zero signs of any acute ulcer formation. He consistently repositioned and made a conscious effort to remove any pressure from bony prominences. Ultimately, the pressure sores healed with no signs of pre-existing sores at the time of discharge.

Strength: Following physical therapy, the patient's UE strength equaled 4+/5 throughout. His LE strength improved and equalled as follows: 4/5 hip abduction,4/5 hip flexion, 4+/5 knee extension, 5/5 ankle dorsiflexion, 3+/5 plantarflexion, 4/5 knee flexion, and 4/5 hip adduction. Patient's coordination and awareness of his movements during his daily activities improved. Also, the patient complained of less fatigue at the end of therapy as compared to the beginning. He felt comfortable and pleased with the strength gains made over the course of therapy.

Single leg stance: The patient was able to single leg stand in parallel bars for 5 min with minimal use of UEs on bars. See table 1. The single leg stance was by far the most difficult exercise that this patient would perform, but also one of the most beneficial.

Bed mobility: The patient improved his independence with bed mobility from moderate assistance of one to modified independent with use of bed rails. He was very

pleased at the end of therapy to be able to move into and out of bed independently. This took a lot of stress off the patient and his family.

Transfers: The patient became independent with his wheelchair transfers to and from the toilet and the bed with the use of a beezy board. He remained wheelchair bound following PT intervention with no prosthetic device due to lack of standing balance and stamina. Following this episode of care, the patient's family felt comfortable with him performing most transfers at home independently.

Home Health: Once the patient returned home, he would be receiving home health services from both physical therapy and occupational therapy daily. These services would hopefully create a smoother transition home and reduce stress and anxiety from the patient and his family.

Chapter V

DISCUSSION

Amputations can pose numerous problems for the patient. There are no absolute correct ways of treating a patient with an amputation. Therapy may need to be flexible and adjust according to what the patient can tolerate, which is what this case study hopefully illustrates. In the early phases of rehab, physical therapy was slow. Simple seated exercises were the bulk of his therapy to help increase his overall strength. As patient's treatment progressed, functional exercises appeared to be the most beneficial treatment options for this patient. Interventions including sit to stands, toilet transfers, and bed mobility appeared to be the activities that best improved his independence and function. For future reference, I would definitely use a LEFS assessment tool to better gauge the patient's increase in function and independence over the course of therapy.

This case presentation is one that is not often present in health care. Most often, the sequence of events for an amputee is surgery, recovery and strengthening, fitting for a prosthetic, and resuming every day activities. Sometimes the events don't always happen as planned or occur in that order. This patient was not in the norm for a typical amputee recovery, which was frustrating for the patient and his family. Furthermore, this case poses the question: which intervention strategies are best for an amputee that does not have the strength or ability to get fit with a prosthetic. Further research should be conducted utilizing amputee patients with this level of impairment and low level of

independence. Most research has been conducted on patients that have already been fit with a prosthetic and have the strength and ability to walk quickly and efficiently after surgery. Also, research derives into which balance, strengthening, and functional exercises should be utilized following an amputation to increase the likelihood of positive outcomes; however, there is minimal regarding the research for the more physically impaired and lower independent amputee. Low population numbers and lack of research funds towards this specific case may be just a few of the reasons why studies of that nature have not been completed. This case study hopefully inspires researchers to study a sample of people with these impairments and challenges. If a study of this caliber were to be completed, the world of amputees, diabetes, and physical therapy may certainly benefit.

REFLECTIVE PRACTICE

In reflection of this case management, there were some things that could have been addressed differently. A more complete and thorough history taking would have been beneficial. There are more questions that should have been asked initially. Throughout the time of care, I was able to ask questions and derive information relative to his home, family situation, and goals. Things that should have been addressed at the beginning. Also, I feel that there were times that physical therapy possibly progressed the patient a little too far. He had a stubborn personality always wanting to beat his previous treatment session; therefore, PT would challenge him at each and every therapy appointment. There were times that he would be exhausted at the end of treatment. Most of the time that would be a great thing for a patient, but not for this type of patient. Rest, recovery, and relaxation can often be just as important, if not more important, as exercise and strengthening. Energy conservation becomes a valuable tool in the health care setting and should always be monitored with low conditioned patients.

Finally, the LEFS assessment tool should have been utilized. Many research articles rave about the great qualities of the LEFS . Even though the patient was extremely weak initially, I should have instituted the assessment once his strength, stamina, and balance elevated.

As stated previously, this particular patient was unique. He does not have the strength, tissue healing, and proprioception/balance to be fitted for a prosthetic. So what

interventions and plan of care is most appropriate? Further research needs to be conducted to determine what plan of action should be taken for a patient of this mag

References

1. Perry J, MacKenzie E, Bosse M. Below-the-knee compared with above-the-knee amputation. *J Bone & Joint Surg, American Volume*. 2005;87A(5):1162-1163.

2. Nolan L. A training programme to improve hip strengthen in persons with lower limb amputation. *J Of Rehab Med*. 2012;44(3):241-248.

3. Moxey P, Gogalniceanu P, Holt P, et al. Lower extremity amputations - a review of global variability in incidence. *Diabetic Medicine*. 28(10):1144-1153.

4. Li Y, Burrows N, Gregg E, Albright A, Geiss L. Declining rates of hospitalization for nontraumatic lower-extremity amputation in the diabetic population aged 40 years or older. *Diabetes Care*. 2012;35(2):273-277.

5. Yisahak S, Beagley J, Hambleton I, Narayan K. Diabetes in North America and The Caribbean: An update. *Diabetes Research & Clinical Practice*. 2014;103(2):223-230.

6. Dillingham TR, Pezzin LE, MacKenzie EJ. Limb amputation and limb deficiency: epidemiology and recent trends in the United States. *South Med J*. 2002; 95: 875-883.

7. Boulton AJ, Vileikyte L, Ragnarson-Tennvall G, Apelqvist J. The global burden of diabetic foot disease. *The Lancet*. 2005;366(9498):1719-1724.

8. Hoffmann F, Claessen H, Morbach S, Waldeyer R, Glaeske G, Icks A. Impact of diabetes on costs before and after major lower extremity amputations in Germany. *J Diabetes Complicat*. 2013;27(5):467-72.

9. Sen C, Gordillo G, Longaker M, et al. Human skin wounds: a major and snowballing threat to public health and the economy. *Wound Repair & Regeneration.* 17(6):763-771.

10. Pauley T, Devlin M, Heslin K. Falls sustained during inpatient rehabilitation after lower limb amputation: prevalence and predictors. *A J Of Phys Med & Rehab.* 2006;85(6):521.

11. Gervais T, Burling N, Sibley K, et al. Understanding Approaches to Balance Assessment in Physical Therapy Practice for Elderly Inpatients of a Rehabilitation Hospital. *Physiotherapy Canada.* 2014;66(1):6-14.

12. Hendershot B, Nussbaum M. Persons with lower-limb amputation have impaired trunk postural control while maintaining seated balance. *Gait & Posture.* 2013;38(3):438-442.

13. Boulton A. Why bother educating the multi-disciplinary team and the patient -- the example of prevention of lower extremity amputation in diabetes. *Patient Ed & Counsel.* 1995;26(1-3):183-188.

14. Binkley JM, Stratford PW, Lott SA, Riddle DL; North American Orthopaedic Rehabilitation Research Network. The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinical application. *Phys Ther.*1999;79:371–383.

15. Wong C. Interrater Reliability of the Berg Balance Scale When Used by Clinicians of Various Experience Levels to Assess People With Lower Limb Amputations. *Phys Ther.* 2014;94(3):371-378.

16. Miller W, Deathe A, Speechley M, Koval J. The influence of falling, fear of falling, and balance confidence on prosthetic mobility and social activity among individuals with a lower extremity amputation. Archives Of Phys Med. & Rehab. 2001;82(9):1238-1244.

17. Singh N, Armstrong DG, Lipsky BA. Preventing foot ulcers in patients with diabetes. JAMA. 2005;293(2):217-28.

18. Nemcová J, Hlinková E. The efficacy of diabetic foot care education. *J Clin Nurs*. 2014;23(5-6):877-82.

19. Alexander NB, Grunawalt JC, Carlos S, Augustine J. Bed mobility task performance in older adults. *J Rehabil Res Dev*. 2000;37(5):633-8.

20. R.E. Pecoraro, G.E. Reiber, E.M. Burgess Causal pathways to amputation: basis for prevention. *Diab. Care*. (1990)513–521

21. Eleftheriadou I, Tentolouris N, Argiana V, Jude E, Boulton AJ. Methicillin-resistant Staphylococcus aureus in diabetic foot infections. *Drugs*. 2010;70(14):1785-97.

22. Centers for Disease Control and Prevention. National diabetes fact sheet: general information and national estimates on diabetes in the United States, Centers for Disease Control and Prevention, Atlanta, 2005.

23. Ziegler-graham K, Mackenzie EJ, Ephraim PL, Travison TG, Brookmeyer R. Estimating the prevalence of limb loss in the United States: 2005 to 2050. *Phys Med Rehabil*. 2008;89(3):422-9.

24. Hermodsson Y, Ekdahl C, Persson B. Outcome after trans-tibial amputation for vascular disease: a follow-up after eight years. *Scandinavian J Of Caring Sci*. 1998;12(2):73-80.