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## Care for an elderly person after lower limb amputation

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### Abstract

**Introduction:** Although currently less major amputation is performed, due to more effective revascularization and endovascular treatment, limbs amputations are still necessary and commonly used as a therapeutic method. Amputation of the lower limb is associated with long-term hospitalization, treatment, rehabilitation and a high level of mortality among older people. For the elderly, additionally suffer from number of chronic diseases, who for various reasons amputation of the limb is the only possible treatment option, recommendations regarding further care after such surgery are important.

**Results:** Causes of lower limb amputation include ia. non-traumatic reasons like diabetes or infection and traumatic ones. Frequency of removal of the lower limb, regardless of its reason is estimated about 5.6 to 600 per 100,000 people and the percentage is about 20 times higher in diabetes-suffering people than in non-diabetic. In the case of this disease, amputations mainly concern men over 60 years of age, as well as people who have been subject to hospital treatment many times. Care for a patient who is prepared to amputation procedure include pre- and post-operative rehabilitation,

prosthesis of amputated limb, psychological care, patient education and also pharmacotherapy. It is important to give to patient enoxaparin to reduce thromboembolic risk. To increase quality of life after amputation it is important to provide adequate nursing care.

**Discussion:** Other overlooked diseases, which can lead to lower limb amputation are ia. Charcot disease. Proper diagnosis, differentiation and treatment process is extremely important cause can allow patient to avoid the amputation.

**Conclusion:** Gathered recommendations for correct, high-quality, multi-faceted medical care for patients after amputation of the lower limb will improve the quality of medical services for this group of patients.

**Keywords:** elderly person; lower limb; amputation

## Introduction

According to some reports, the number of major amputations has decreased in the last decade. It may have been caused by the increasing aggressiveness in revascularization and endovascular intervention. Major amputations are still commonly performed. Even though in some hospitals the aggressive revascularization in order to cure the limbs is preferred, the amputations are still performed there. As for patients who had been undergoing revascularization attempts without success, those who had other diseases, those whose anatomical features didn't let them undergo a revascularization, or those with infections and a big surface of damaged tissue –had to undergo a major amputation. When it comes to prosthesis, to reduce the energy expenditure, if possible, the knee joint should be maintained. [1] Several studies show, that the number of patients with a advanced manifestation of PAD ( peripheral arterial disease) - CLI (critical leg ischemia) – has increased due to the population's aging. A CLI patient is often an older person, suffering from comorbid diseases. This patient also has a tendency for such complications as myocardial infarctions or strokes. A quarter of patients with CLI is going to have an amputation performed within the year of the diagnosis. The amputation lets the patients eliminate the pain and stop a gangrene infection particularly when they have any wounds, suffer from diabetes or when there's no option of undergoing revascularization. [2] As for the diabetic foot syndrome among type 2 diabetic patients, there are studies to prove that the risk factors related to a major lower limb amputation were: a diabetes which was present for at least 15 years, when HbA1c value was at least 8%, the patient was on insulin, the patient had hypertension, cardiac diseases, chronic renal impairment, underwent a stroke, a gangrene, patients with other components, ischemia or a higher Wagner classification. A significant difference in the rate between sexes hasn't been proven. [3] A major amputation of the lower extremity is defined as a thigh or leg amputation. As for the diabetic foot, patients older than 65 years had a 1.9 times higher risk to be qualified for a major amputation of the lower extremity. [4] According to some reports, CABG surgery, diabetic retinopathy and Charcot's arthropathy increase the risk of undergoing an amputation in prospect. [5]

## Results:

### 1. Causes of lower limb amputation.

Amputation of the lower limb is associated with long-term hospitalization, treatment, rehabilitation and a high level of mortality among older people. As for the causes of amputation of the lower limbs, we distinguish between traumatic and non-traumatic causes. The most common cause of non-traumatic limb loss is long-term poorly treated diabetes and infection. Diabetes causes damage to the blood vessels causing their overgrowth, loss of elasticity and the formation of atherosclerotic plaques. This results in ischemia and consequently, necrotic changes and amputation. [6]

When it comes to traumatic amputations, they most often resulted from accidents of motor vehicles, next in the queue there were accidents related to the servicing or assembly of machines. In today's population, traumatic amputations are not anything special, more and more people have cars, more and more works a few positions, hence an increase in accidents. In these events, the amputation usually only has one limb, which does not mean a significant increase in mortality risk, worse if the limb is amputated several times, then the risk increases rapidly. [7]

The reason lies also in the mentality of society, understood as the lack of control over health,

the lack of diagnostic tests, the lack of basic knowledge about the disease. This is mainly about vascular changes that cover a large part of the population, especially older people. One can not forget about clinicians who also overlook important risk factors. [8]

Neurogenic arthropathy, otherwise known as Charcot joints, is another important predisposing factor for amputation of lower limbs. It is a late complication of diabetes and diabetic polyneuropathy. In older people who often coexist with osteoporotic changes they have a greater predisposition to bone deformation. Therefore, the effect of neurogenic arthropathy is increased. [9]

Arthroplasty of the knee joint, or surgical reconstruction, may be associated with an infection secondary to this surgery. This is a serious condition that persuades the surgeons to amputate above the knee in order to control the infection. Fortunately, this happens relatively rarely, the percentage of patients qualified for amputation due to infection is 0.10%. [10]

## **2. Epidemiology of lower limb amputation.**

Due to the fact that amputations of the lower limb are most often the result of the diabetic foot syndrome, in this case they are the most common indication for hospital treatment. The incidence of amputations associated with diabetic foot is estimated to be up to 20 times higher than for non-diabetics. In the case of this disease, amputations mainly concern men over 60 years of age, as well as people who have been subject to hospital treatment many times. [11, 12, 13, 14]

Amputations most often affect diabetics than healthy people. The diabetic foot syndrome is associated with 20% of people who have diabetes, typically type 2 and have a neuropathic base. [13]

The exact frequency of removal of the lower limb, regardless of its type in people suffering from diabetes, ranges from about 5.6 to 600 per 100,000 inhabitants in the world, with the incidence in non-diabetic people from 5.8 to 31 per 100,000 inhabitants. [15]

The inevitable complication of amputation in the course of diabetic foot is death. It is estimated that as a result, mortality among patients ranges from 5-17%. In addition, during the first 12 months after the surgery, 13-40% of them die, and after about 5 years, the percentage may be the highest 80%. The results of the study also confirm that the risk of death is much higher in the case of diabetic foot than cancers. [12]

In second place, as to the frequency of occurrence, there are amputations necessary to perform after traffic accidents, war injuries or electric shocks, i.e. traumatic amputations. They are more frequently performed in men than in women. [11]

The rarest indication for amputation is malignancy. The development of medicine and much more effective diagnostic processes allow for the rapid detection of cancer and the use of implants, thus preventing the removal of the limb. [11]

According to the research carried out over 4 years, the number of non-traumatic lower limb amputations below or above the knee joint has increased from 7703 in 2009 to 8111 in 2012. The number of same types of amputations in diabetic patients increased from 3731 in 2009 to 4598 in 2012. The National Health Fund database also registered the number of major amputations that were repeated with the same people throughout the year. For example, in 2011 one person underwent a 4-fold amputation, while in 172 people it was repeated. In 2012, one person underwent amputation 5 times, while in 199 people the amputation was performed a second time. [15]

## **3. Pharmacological treatment carried out with amputations.**

Main preparation to the amputation is called pre-operative rehabilitation. It consist of physical activity, rehabilitation with psychologist and education about rehabilitation process. [16] Of course there is also pharmacological treatment.

If we decide about amputation it is very important to reduce thromboembolic risk. Patients are

given low molecular weight heparin (enoxaparin). 12 hours before amputation is optimal time to reduce risk of thrombosis to 9,75%. This method is both efficient and safe. Therefore heparin should be discontinued promptly in case of developing thrombocytopenia. Of course if we have an operation with high risk of bleeding it is required to stop taking antiplatelet drugs. For example klopidoogrel is excluded from treatment 5 days before an operation.

We have two methods of anesthesia, which are used in amputations – spinal and general. Many factors determine our choice between both of them, for example: patient satisfaction, postoperative hospital stay, postoperative pain scores, cost-effectiveness. [17]

Extremely interesting phenomenon, which unfortunately affects a large proportion of people after amputations is phantom limb pain. It is said that it concerns between 60% and 90% patients with amputated limb. We can treat it in both ways: pharmacological and non-pharmacological. Drugs belonging to the first of them are: tricyclic antidepressants, narcotic drugs, anti-epileptic medications, analgesics. To the second we can count methods as: transcutaneous electrical nerve stimulation, acupuncture. One of the novelties is mirror therapy, which is one of physiotherapeutic method. Neither pharmacological nor non-pharmacological treatment has clearly proven effects.

A very common medical condition in limb amputees is depression and posttraumatic stress disorder (PTSD). For patients amputations very often are traumatic events and they are associated with intense fear and anxiety. [18] Patients can be helped by building social support, individual psychotherapy. Unfortunately, people after amputations are very often left alone and their only therapy are drugs, including: tricyclic antidepressants, monoamine-oxidase inhibitors, SNRI, SSRI, NRI.

Novelty in the treatment of people after a hand amputation are regenerating substances (RGTA). Advantages of this method are: acceleration of the healing process and stimulating the vitality of skin grafts. No contractures when achieving a large range of movements.

#### **4. Prosthesis after amputation of the lower limb**

Choosing the right prosthesis is part of comprehensive treatment of older people with amputations. Amputation within the lower limb limits the ability to move, and walking reeducation is one of the main goals of rehabilitation in this group of patients. The use of appropriate prosthetic supplies in patients after amputation is an important element of therapy, because it is related to the improvement of the quality of life and the possibility of restoring the lost function - locomotion. When preparing the elderly for the purpose of explaining, this group is characterized by reduced physical capacity, circulation within the stump is smaller, and the blood vessels are more fragile. Therefore, prostheses for the elderly must be above all comfortable and light. [19, 20, 21]

As the first after amputation, temporary prostheses are used in order to quickly position the patient. The prosthesis socket is made of special materials - a thermoplastic board or an epoxy resin. The temporary shin prosthesis consists of: a prosthesis socket, a connecting plate, a tilting insert, a shin element and a foot. The construction of the temporary thigh prosthesis is similar. Currently, there are different dentures, selected individually for the patient, depending on the level at which the amputation was performed. [22]

Thigh amputation prostheses are divided into two groups: traditional and modular. The former are very durable and inexpensive, but not very aesthetic. Modular prostheses are light and in case of this type of bracing the gait becomes more similar to the correct one, however, they are more expensive to make. The prosthesis socket provides adequate pelvic stabilization. It must be chosen so that it can be stably fixed in it. To make this element of the prosthesis, laminates, silicone elements and plastics are used. Currently, MAS (Marlo Anatomical Socket) is one of the newer prosthesis socket to make the thigh more stable. It is particularly well tolerated by older people. If the stump is short, or if it has been distorted - the prosthesis socket thigh fracture is a better solution. It increases the stabilization of the stump and also improves locomotion. Stabilization in the support phase is ensured by the knee joint, which due to the reduced efficiency of older patients is uniaxial, with a locking closure. In traditional prostheses, to improve the straightening of the shin, external knee launchers are used, while in modular prosthesis knee joints are mechanical or with a hydraulic mechanism. There are also prostheses with a free knee joint. In this case, stabilization is achieved by placing the foot in the plantar flexion. The stump is exposed to injury, and stump stockings are used to

avoid this. Made, for example, of knitted cotton or wool. If the amputation occurred as a result of diabetes complications - silicone stockings are useful. [22, 23].

Certain restrictions are after amputations of the shin, because the distal part of the stump is poorly supplied with blood and particularly sensitive to pressure. The most important part is a well-chosen prosthesis socket. In the case of a prosthetic socket, a PTB (patellar tendon bearing) is usually used, including the femoral condyle and patella. This applies to long stumps, in short ones - PTS (prothese tibiale supracondylienne) is recommended, which limits the extension of the knee joint. The use of the PTB prosthesis socket is additionally associated with the weakening of the quadriceps muscle of the thigh, because for fixing you need the special strips, which press against the thigh over the knee joint. Another type of prosthesis socket is KMB (kondylenbettung Munster). Includes patella (lower part) and femoral condyles. Weakened stabilization of the knee joint, especially in the elderly, requires the use of a special cuff with side rails. The prosthetic foot plays the supporting function. Dynamic foos are often used to reduce energy expenditure while walking. In addition, light materials are used to make them, which in turn improves walking dynamics. [22]

In the case of partial amputation within the foot, a typical orthopedic supply is not used, only a prosthetic filling, which in the elderly must be very well-fitting and soft. If the amputation includes the joints of Chopart and Lisfranca - the prosthesis is adapted to the height of the amputation, including the shin. To make such prostheses, carbon fiber or epoxy resin is used. [21, 22]

Prosthetics is a branch of medicine still developing. At the turn of recent years, there has been a great progress in the creation of prostheses after amputation of the lower limbs. They are primarily more functional and allow patients to restore the lost function of locomotion.

## **5. Nursing care after lower limb amputation.**

Amputation is associated with significant changes that may have a negative impact on the patient's quality of life. [1] Nursing care affects the psychophysical condition and functioning of the patient, reducing the complications resulting from limb loss. Depending on the stage of convalescence, the priorities in nursing care change according to the patient's needs. The main factors determining the type of care services include presence of pain, need for care for the stump or preparing it for prosthesis, and need for psychological support. [24, 25]

Post-amputation pain occurs in about 70% of patients undergoing surgery and is considered to be their dominant problem. It may be associated with the postoperative wound, remained part of the limb or take the form of phantom pain. Effective pain elimination is a very important part of treatment - minimizing the response of the nervous system, supports the healing and convalescence of the patient. Untreated pain may be associated with emotional problems, severe stress and insomnia. [24, 26] The most important tasks undertaken by the nurse include systematic assessment of pain using scales (numeric pain scale, visual pain scale), administration of painkillers according to the doctor's order and keeping records of the effectiveness of the treatment based on the patient's response. [24]

Proper observation and care for the stump allows preventing complications associated with healing of the post-operative wound, the formation of contractures, complications from the nervous and vascular systems, and allows later prosthesis. [24, 25] Regular wound assessment enables early identification of bleeding, amount and type of exudate, development of infection, edema and reduced circulation within the limb that could adversely affect the healing process and result in complications. The wound should be thoroughly cleaned and dried before changing the dressing. [24] Proper bandaging allows to shape the stump correctly and prevents edema - a too tight dressing could lead to ischemia of the stump, while too loose would make it difficult to shape the stump for prosthesis fitting. [24, 25]

Another important aspect is the proper placement of the stump - in order to prevent the increase of edema, low positioning (dangling) should be avoided. Especially in the first days after amputation the stump should be elevated [24]. In order to protect the patient against contractures in the hip and knee joints, it is necessary to change the patient's position regularly. The amputated limb should be placed in abduction of the hip joint. [25]

Disability caused by amputation of the lower extremity may result in psychological problems leading to a decrease in the quality of patient's life. [27] The necessity to accept a different appearance of the body and change of heretofore life may cause strong emotional reactions, such as anxiety, restlessness, depression or powerlessness. [25, 26] The nurse's tasks include quick involvement and

education of the patient and his family about the care of the stump. The high individuality of subject's response to amputation requires the nurse to respect their feelings about the disability and to provide mental support at all stages of the convalescence process. [24] Patient's environment has a significant influence on their self-acceptance. The patient should be informed about support groups available in his environment - it has been proven that there is an important relation between the increase in social support received by the patients and the improvement of functioning and quality of life after amputation. [24, 27]

## **Discussion**

In our paper we want to sensify you on the problem of care over an elderly person after amputation of the lower limb. Although we point that there are other ways of treatment other than amputation it is still in use due to advanced progression of illness, comorbid disease or patients physiologic that force us to abscission part or whole leg. [1, 28]

In our paper we mention Charcot foot disease, because it can be misdiagnosed (e.g. as infection) especially among seniors. This is why it is good to know signs of neuroarthropathy and how to treat it, because in some cases Charcot foot can come up without diabetes mellitus being diagnosed. [29]

In advance with patient that is at risk with amputation, during amputation, and also after, it is necessary to treat them using appropriate pharmacotherapy. Depending on country the major cause of amputation can be different but researches show that the most of the cases is led by peripheral artery disease and trauma. [7, 28, 30, 31] Accidents may lead to posttraumatic stress disorder that can disturb patient adaptation to new situation, carry them to overuse prescribed medication. This is why it is important to remember about PTSD and that it can be treated through psychotherapy and pharmacotherapy. [32, 33] Amputee can suffer from phantom pains to treat which we have got many different approaches and it is important to help them find best way of treatment. Due to unsatisfactory results of pharmacotherapy, we should probably try to combine pharmacotherapy, procedure and psychotherapy. [34, 35, 36]

We want to note that for improving patients quality of life and reducing possibility of occurring side effects from operation or postoperative period there is crucial need for nursing care and proper pain treatment. Others studies also show importance of complex charge not only in physical sphere where should be stump assessment, nursing and rehabilitation but also in psychological sphere. [24, 28, 32]

You need to come to understanding with your patient about his expectation. This way you can suggest appropriate type of prosthesis. During this conversation you should choose type of artificial limb, according to patient functional ability, and also you should suggest as an alternative a mobility supportive units (e.g crutches, wheelchair), because studies show unfavourable correlation between prosthetic prescription rate in compliance with older age. [32, 37, 38]

## **Conclusions**

In this article we tried to present a variety of aspects of a problem which is the care over an elderly people after amputation of the lower limb. Amputation is a very common phenomenon concerning more often diabetic than healthy people. According to epidemiological data, the main cause is the diabetic foot syndrome usually associated with type 2 diabetes, especially if the disease lasts for more than 15 years, the HBA1C index is above 8 percent, the CABG were transferred and retinopathy appeared. The high- risk group may also include patients with CLI whose treatment aims to eliminate pain and stop the development of necrosis.

Causes may also be divided into traumatic- traffic accidents and non-traumatic ones, such as untreated diabetes and neurogenic arthropathy. Less frequent are secondary infections due to knee arthroplasty and lower extremity malignant tumors.

Pharmacotherapy includes preparation of the patient for the amputation procedure as well as treating its complications. Before the surgery low molecular weight heparin, which will increase the risk of thromboembolic complications, should be given. In order to relieve the symptoms of the most important complications of the procedure, such as phantom pain, depression and post-traumatic stress disorder, we use tricyclic antidepressants. After the amputation of the hand, substances that accelerate regeneration are also used.

Loss of the limb influences significantly the quality of life of the patient, therefore the scope of care should not only include pharmacotherapy but also a proper stump care, psychological help and education of the patient and his relatives.

Reeducation of patient's gait due to the use of a properly selected prosthesis is the main goal of rehabilitation. To minimize energy expenditure, amputation should not involve the knee joint. The temporary prosthesis (the first one used after amputation) consist of sockets, connecting plates, tilts and shin elements and feet. With its construction, individual patient's needs are also taken into account. We can classify femoral amputation prosthesis into two groups- traditional and modular- depending on their durability, price and weight. The dynamic development of prosthetics brings hope that in the future the patient's quality of life will be higher than before.

## References

1. Aulivola, B., Hile, C. N., Hamdan, A. D., Sheahan, M. G., Veraldi, J. R., Skillman, J. J., ... & Pomposelli Jr, F. B. (2004). Major lower extremity amputation: outcome of a modern series. *Archives of Surgery*, 139(4), 395-399.
2. Klaphake, S., de Leur, K., Mulder, P. G., Ho, G. H., de Groot, H. G., Veen, E. J., ... & van der Laan, L. (2017). Mortality after major amputation in elderly patients with critical limb ischemia. *Clinical interventions in aging*, 12, 1985.
3. Shatnawi, N. J., Al-Zoubi, N. A., Hawamdeh, H. M., Khader, Y. S., Garaibeh, K., & Heis, H. A. (2018). Predictors of major lower limb amputation in type 2 diabetic patients referred for hospital care with diabetic foot syndrome. *Diabetes, metabolic syndrome and obesity: targets and therapy*, 11, 313.
4. Khalfallah, M., Gouta, E. L., Dougaz, W., Jerraya, H., Samaali, I., Nouira, R., ... & Dziri, C. (2018). Predictive factors for major amputation of lower limb in diabetic foot: about 430 patients. *La Tunisie medicale*, 96(5), 298-301.
5. Rodrigues, B. T., Vangaveti, V. N., & Malabu, U. H. (2016). Prevalence and risk factors for diabetic lower limb amputation: a clinic-based case control study. *Journal of diabetes research*, 2016.
6. Lazzarini, P. A., Clark, D., & Derhy, P. H. (2011). What are the major causes of lower limb amputations in a major Australian teaching hospital? The Queensland Diabetic Foot Innovation Project, 2006–2007. *Journal of foot and ankle research*, 4(S1), O24.
7. Barmparas, G., Inaba, K., Teixeira, P. G., Dubose, J. J., Criscuoli, M., Talving, P., ... & Demetriades, D. (2010). Epidemiology of post-traumatic limb amputation: a National Trauma Databank analysis. *The American Surgeon*, 76(11), 1214-1222.
8. Swaminathan, A., Vemulapalli, S., Patel, M. R., & Jones, W. S. (2014). Lower extremity amputation in peripheral artery disease: improving patient outcomes. *Vascular health and risk management*, 10, 417.
9. Sohn, M. W., Stuck, R. M., Pinzur, M., Lee, T. A., & Budiman-Mak, E. (2010). Lower-extremity amputation risk after Charcot arthropathy and diabetic foot ulcer. *Diabetes care*, 33(1), 98-100.
10. Fedorka, C. J., Chen, A. F., McGarry, W. M., Parvizi, J., & Klatt, B. A. (2011). Functional ability after above-the-knee amputation for infected total knee arthroplasty. *Clinical Orthopaedics and Related Research®*, 469(4), 1024-1032.
11. Pogorzala, A. M., & Rohde, A. (2018). Przyczyny, rodzaje i poziomy amputacji kończyn dolnych. Fizjoterapia – wiedza i doświadczenie 1-12.
12. Mrozikiewicz-Rakowska, B., Krasnodębski, P., Karliński, M., Nehring, P., Rosiński, G., Zemlak, M., ... & Karnafel, W. (2011). Czynniki ryzyka amputacji kończyn dolnych w zespole stopy cukrzycowej. *Leczenie Ran*, 8(1), 15-20.
13. Wanot, B., Nierobisz, E., & Biskupek-Wanot, A. (2017). Lower limb amputation as the most

serious complication of diabetes mellitus. *Medycyna Rodzinna*.

14. Wolnik-Piernicka, K., Hałoń-Gołąbek, M., Wolnik, B., Hansdorfer-Korzon, R., & Korzon-Burakowska, A. (2017). Physiotherapeutic approach in managing a patient after below-knee amputation due to diabetic foot syndrome. *Clinical Diabetology*, 6(6), 218-220.
15. Czeleko, T., Śliwczyński, A., Nawrot, I., & Karnafel, W. (2014). The incidence of major, nontraumatic lower amputations in patients without diabetes mellitus in Poland during 2009–2012, based on Polish National Health Found data. *Acta Angiologica*, 20(3), 124-131.
16. Butler, D. J., Turkal, N. W., & Seidl, J. J. (1992). Amputation: preoperative psychological preparation. *J Am Board Fam Pract*, 5(1), 69-73.
17. Yazdi, A. P., Bameshki, A., Salehi, M., Kazemzadeh, G., Razavi, M. S., Rahmani, S., & Hashemy, S. I. (2018). The Effect of Spinal and General Anesthesia on Serum Lipid Peroxides and Total Antioxidant Capacity in Diabetic Patients with Lower Limb Amputation Surgery. *Archives of Bone and Joint Surgery*, 6(4), 312.
18. Bhuvanewar, C. G., Epstein, L. A., & Stern, T. A. (2007). Reactions to amputation: recognition and treatment. *Primary care companion to the Journal of clinical psychiatry*, 9(4), 303.
19. Łuczak, E., Słaba, S., Rochmiński, R., & Rżewska, E. (2014). Ocena poprawności i sprawności chodu u pacjentów po amputacji kończyny dolnej w obrębie uda. *Acta Bio-Optica et Informatica Medica. Inżynieria Biomedyczna*, 20(1), 29-38.
20. Raichle, K. A., Hanley, M. A., Molton, I., Kadel, N. J., Campbell, K., Phelps, E., ... & Smith, D. G. (2008). Prosthesis use in persons with lower-and upper-limb amputation. *Journal of rehabilitation research and development*, 45(7), 961.
21. Marciniak, W., & Szulc, A. (2008). Wiktora Degi ortopedia i rehabilitacja. *PZWL, Warszawa* 561-568.
22. Przeździak, B., & Nyka, W. (2008). *Zastosowanie kliniczne protez, ortoz i środków pomocniczych*. Via Medica.
23. Crowe, C. S., Impastato, K. A., Donaghy, A. C., Earl, C., Friedly, J. L., & Keys, K. A. (2019). Prosthetic and orthotic options for lower extremity amputation and reconstruction. *Plast Aesthet Res*, 6(4).
24. Virani, A., Werunga, J., Ewashen, C., & Green, T. (2015). Caring for patients with limb amputation. *Nursing Standard (2014)*, 30(6), 51.
25. Ruszkowska, E. (2008). Szewczyk M. *Rola pielęgniarki w opiece przedoperacyjnej i pooperacyjnej nad chorym poddawanym amputacji kończyn dolnych*. *Pielęgniarstwo Chirurgiczne i Angiologiczne*, 2, 56-60.
26. Kostka A., Durlej-Kot S., Chabowski M., Janczak D. (2017). *Opieka pielęgniarska nad pacjentem po amputacji kończyny dolnej na podstawie Międzynarodowej Klasyfikacji Praktyki Pielęgniarskiej (ICNP)*. *Pielęgniarstwo Chirurgiczne i Angiologiczne* 11 (3): 84-93
27. Hawkins, A. T., Pallangyo, A. J., Herman, A. M., Schaumeier, M. J., Smith, A. D., Hevelone, N. D., ... & Nguyen, L. L. (2016). The effect of social integration on outcomes after major lower extremity amputation. *Journal of vascular surgery*, 63(1), 154-162.
28. Conte, M. S., Bradbury, A. W., Kolh, P., White, J. V., Dick, F., Fitridge, R., ... & Aboyans, V. (2019). Global vascular guidelines on the management of chronic limb-threatening ischemia. *European Journal of Vascular and Endovascular Surgery*.
29. Jansen, R. B., Jørgensen, B., Holstein, P. E., Møller, K. K., & Svendsen, O. L. (2018). Mortality and complications after treatment of acute diabetic Charcot foot. *Journal of Diabetes and its Complications*, 32(12), 1141-1147.
30. Guest, F., Marshall, C., & Stansby, G. (2019). Amputation and rehabilitation. *Surgery (Oxford)*.
31. Soares, T. R., Manuel, V., Amorim, P., Martins, C., e Melo, R. G., Ministro, A., ... & Pedro, L. M. (2019). HYBRID SURGERY IN LOWER LIMB REVASCULARIZATION: A REAL-WORLD EXPERIENCE FROM A SINGLE-CENTRE. *Annals of vascular surgery*.
32. Webster, J. B. (2018). Lower Limb Amputation Care Across the Active Duty Military and Veteran Populations. *Physical Medicine and Rehabilitation Clinics*.
33. Kearns, N. T., Powers, M. B., Jackson, W. T., Elliott, T. R., & Ryan, T. (2018). Posttraumatic stress disorder symptom clusters and substance use among patients with upper limb amputations due to traumatic injury. *Disability and rehabilitation*, 1-8.
34. Flor, H. (2002). Phantom-limb pain: characteristics, causes, and treatment. *The Lancet Neurology*,



1(3), 182-189.

35. Ahuja, V., Thapa, D., & Ghai, B. (2018). Strategies for prevention of lower limb post-amputation pain: A clinical narrative review. *Journal of anaesthesiology, clinical pharmacology*, 34(4), 439.

36. Cárdenas, K., & Aranda, M. (2017). Uso de psicoterapias como tratamiento del dolor de miembro fantasma. *Revista Colombiana de Psiquiatría*, 46(3), 178-186.

37. Kurichi, J. E., Kwong, P. L., Reker, D. M., Bates, B. E., Marshall, C. R., & Stineman, M. G. (2007). Clinical factors associated with prescription of a prosthetic limb in elderly veterans. *Journal of the American Geriatrics Society*, 55(6), 900-906.

38. Onat, S. S., Ünsal-Delialioğlu, S., & Özel, S. (2017). The importance of orthoses on activities of daily living in patients with unilateral lower limb amputations. *Journal of back and musculoskeletal rehabilitation*, 30(4), 829-833.