

## Case Report

# Dysvascular Transtibial Amputation Due to Artery Stenosis: A Case Report Study

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### ABSTRACT

Below-knee (BK) amputation is one of the most commonly performed actions in dysvascular cases, but rare caused by arterial stenosis. Those had significant impacts on clinical functions and affect the contralateral limb, so its need adequate supervision during rehabilitation programs. The report are to describe the stump wound healing of the patient after amputation surgery, stump preparation at pre-prosthetic phase, prevention of knee contracture, prosthetic preparation and use, gait training and evaluation of unaffected limb. A 44-years old female with right below-knee amputation caused by stenosis of right peroneal and dorsalis pedis artery, and the wound in the residual limb was not healed within 4 weeks. She got rehabilitation to accelerate stump healing and stump shaping, maintain knee flexibility, muscle strengthening, cardiovascular endurance, transfer and ambulation. She had good compliance to the programs and achieved independent ambulation using the prosthetic within 6 months. Improvement in residual limb healing within 6 weeks, pain reduction from VAS score 3 to zero, and stump shape changes from buldging to conical. And also in knee joint range of motion, transfer ability, gait pattern using BK prosthetic (by modifying shoe components), and the patient's ability to carry out ADL (BI score 75 to 100). Laser therapy, stump shaping, flexibility exercise, strengthening exercise, endurance exercise, ambulation exercise and prosthetic use on transtibial dysvascular amputation showed good results for ADL. Careful examination to the unaffected limb could identify early occurrence of stenosis. Early intervention could prevent future ischaemia and amputation.

**Keywords:** *artery stenosis, below-knee amputation, below-knee prosthesis, dysvascular amputation, rehabilitation program*

## Introduction

The prevalence of limb amputation was approximately 1.6 million people in 2005 and estimated to be doubled in 2050.<sup>1</sup> It was found that 75-93% of lower limb amputation occurred due to vascular disease.<sup>2</sup>

Lower limb amputation level varies depending on the etiology, with the most common are the thumb amputation, transtibial amputation and transfemoral amputation.<sup>3</sup> In determining the level of amputation, the biological level and the accepted level of rehabilitation need to be considered because the result of amputation would affect body image, self-care activities, mobility, psychosocial and vocational attributes of an amputee.<sup>4</sup>

In below-knee amputation, it is very important to maintain the presence of the knee joint so that rehabilitation can be carried out to a normal walking pattern as before the illness.<sup>1</sup> Of course, determination of the level of tissue viability, prosthetic selection, gait dynamics, cosmetics and motion biomechanics are considered before the amputation procedure operative management.<sup>5</sup>

In cases of lower limb artery stenosis, the location of the blockage will affect about how much tissue viability left.<sup>5</sup> In this case report, the authors aim to describe the clinical condition of a patient with dysvascular amputation after amputation surgery, during pre-prosthetic phase, and during the rehabilitation programs.

## Material and Methods

### Case report

Mrs. M, 44 years old, was referred from Orthopedic Surgery to the Physical Medicine and Rehabilitation outpatient clinic of Dr. Soetomo General Academic Hospital Surabaya on 13<sup>th</sup> of April 2018 with post right below-knee amputation diagnosis. The patient complained that her right amputated leg had not healed, the wound had not closed especially in the area of stitches, the blood was still apparent in the bandage, and dull pain

sensation was felt (Wong-Baker FACES score/WBFS was 2-3) for short durations, but there was no tingling sensation nor numbness. Patient underwent amputation of the right leg on 7<sup>th</sup> of March 2018 when she found that there was a small bulous form wound in the right foot skin. Patient sought out help from Mojokerto General Hospital for wound care, but the wound got wider. A week later, the toes (finger number 2,3,4,5) became blueish, the foot to the ankle joint area became reddish, there were swelling and excruciating pain (WBFS 8-10). Patient went to hospital again and was told that there was a clog in the blood vessel of the lower leg. The patient then was referred to Surabaya and underwent amputation surgery.

The patient underwent partial amputation of the right big toe approximately 4 years before (in 2014), it started with a nail infection that lead to dark skin appearance. After amputation of the big toe, the wound healed completely and the patient returned to do her daily activities. There was no history of diabetes, hypertension, dyslipidemia, but she was a passive smoker.

The patient's hope was to have a prosthetic leg in order to be able to walk as soon as possible, so that she could help her husband in daily life activities and take care for her two children. The patient worked as a housewife and a seller. Throughout the day the patient took care for her husband's and children's needs, such as preparing meals and tending a grocery store at the front of her house. In the community, the patient regularly joined religion and other social activities.



**Figure 1. Open wound at residual limb**



**Figure 2. Healed wound (6 weeks later)**

### **Physical examination**

The physical examination found that below-knee amputation had bulging stump shape, redness around the wound, open wound along surgical suture with blood seepage (**Fig.1**). During palpation examination, there was warmth and pain around the wound area, no neuroma, phantom pain, phantom sensation, and no telescoping sensation. Stump length was 16cm/31cm= 51%, stump diameter was 28cm (left calf diameter 27cm). There was no muscle atrophy. The proximal pulsation were palpated at the right popliteal artery. The soft tissue coverage was myodesis. Ankle brachial index was 0,9 (left calf), Barthel Index (BI) score was 75. The count test and chest expansion were decreased.

The Physical Medicine and Rehabilitation treatment goals for this patient were to reduce the pain sensation, promote wound healing, reduce edema in the stump area, facilitate function of ambulation, prevent the risk of vascular dysfunction of the left leg, prepare for below-knee prosthetic usage, and improve quality of life (mobilization, psychology, social activity).

In order to stimulate soft tissue

healing; reduce pain and inflammation, the patient was prescribed LASER therapy with scanning method. Prescription of the therapeutic exercise were ROM exercise and strengthening exercise for the lower limbs, breathing exercise, endurance exercise, transfer exercise, gait training using axillary crutches, wound care and shaping of the stump using elastic bandage.

### **Results**

After six weeks of physical rehabilitation, the pain sensation in the stump was reduced to WBFS 1-2, the count test and chest expansion measurements were increased. Local status of amputated leg: cylindrical stump, no redness, surgical wound healed, no blood seepage (**Fig.2**). Stump length 14cm/30cm= 46,7%, diameter 27cm same as left leg. She was able to jump with one leg and to ambulate using crutches. BI score was 90.

We prescribe below-knee prosthesis with specifications as follows: SACH foot, endoskeletal shank, patellar tendon bearing socket and supracondylar suspension. The patient underwent fitting, and gait training using the prosthesis. We educated the patient to evaluate the skin condition around the stump area and evaluate any occurrence of pain or laceration.



**Figure 3. Prosthetic fitting and gait training**

A week after the prosthesis fitting, the patient came back with a complaint of skin blister developed in the scar wound about 1 cm in diameter, without any pain.

We treated the wounded area with LASER therapy for 2 weeks and the blister diminished. The prosthesis was revised and refitted to ensure that there was no pressure from the socket's inner surface to the skin of the stump.

Two weeks after refitting, there was no skin blister or any skin laceration, but she complained an itchy sensation when using prosthetic for 4 hours and more. She also had more confidence when going up and down the stairs. The BI score was 100. She also complained about fatigue when walking using the prosthesis for a rather far distance.

Then, we evaluated the patient's gait while using prosthesis in our Gait Analysis Laboratory. The result showed that the ground reaction force in the prosthetic limb was forwarded too quickly during the stance phase. Then, we recommended her to add a thin pad (height 0,5cm) in the sole of the shoe which the patient used. The pad position was between the forefoot and midfoot. After another gait analysis, the patient informed that the heavy feeling when using the prosthesis and the fatigue in the right lower limb was diminished. The 6MWT showed a VO<sub>2</sub> max result of 13,5.



**Figure 4. Gait Lab analysis using prosthetic**

Seven months later, the patient visited our hospital and complained that the socket felt loose since about 3 months before, but the patient was still able to walk with the BK prosthesis. At this time, to reduce the feeling of loose legs, the patient added thickness of the socks in the stump, so that the attachment felt stronger.

She could walk more than 300 meters, take part in village activities, and did household activities properly. She could also ascend and descend the stairs without worrying about falling.

From physical examination, the diameter of the stump was 2 cm smaller compared to the left leg, the right thigh diameter was 3 cm smaller than the left thigh. The form of the stump became conical, no redness, thickening of the skin in the lateral patella (pressure point). The inner diameter of the socket was 1,5 cm larger than the outer diameter of the stump. We recommended her to revise her prosthesis, especially for the socket. However, the patient chose to do intensive strengthening exercise to increase stump volume before doing revision of the socket.

Patient also felt tingling sensation and numbness on her unaffected leg when walking, the complaints subsided with a five minutes break. Physical examination showed superficial varicose in the left leg, no redness, no cyanosis, no edema, no pain, sensory sensation within normal limits. The peripheral saturation of the upper and lower extremity were: fingers O<sub>2</sub> saturation 97%, toes O<sub>2</sub> saturation 90-93%.

We sent her for consultation and treatment by cardiologist and cardiovascular surgeon. The evaluation of doppler USG of the left leg showed a decrease of velocity in the popliteal artery. CT angiography showed stenosis of posterior tibial artery, popliteal artery and anterior tibial artery. She was given oral antihypertension and antiplatelets medication.

## Discussion

The impairment problems in the patients with amputation show various complex implications to their function as human beings. The treatment needs special supervision, coordination with others specialty, suitable prescribed program and patients compliance. According to the literature, the principles guiding residual limb care are ensuring primary wound healing, controlling pain,

minimizing edema, and preventing contractures.<sup>2</sup>

The patient came to rehabilitation with unprepared residual limb which unfit for prosthesis. That is because of the open wound for more than 2 weeks after the amputation surgery. Physical Medicine and Rehabilitation Department has various modalities to promote tissue healing. In this case, the open wound could be treated using LASER therapy. Low-laser therapy has been known to be beneficial to promote wound healing through several mechanisms such as immunologic response by increasing phagocytic activity of leucocyte and T or B lymphocyte activity, fibroblast activity to enhance wound contraction, collagen synthesis, and increasing tensile strength. LASER can decrease prostaglandin PGE2 which results in decrease of edema. It can also influence the response of neuro-hormonal mechanism through increasing the amount of serotonin and endorphin, decreasing bradikinin, so that the pain will reduce.<sup>6,7</sup>

We also managed the residual limb with soft dressing. We used elastic bandage wrap because it has the advantage of being readily available, quick application, and allowing frequent wound inspection. However, it does not provide protection from external trauma and only has a limited ability to control edema. If they are poorly applied, elastic wraps can lead to tourniquet effect. Elastic bandages require considerable cooperation, skill, and attention on the part of the patient, family, and medical staff because the wraps need to be reapplied frequently and carefully to be successful. We educated the patient to wrap her residual limb properly by herself. Despite a number of limitations, soft dressings remain the most commonly used wound care approach following amputation.<sup>2,8</sup>

This patient's wound healing was achieved in 6-8 weeks. It suited the pre-prosthetic management guideline for lower extremity amputation timeline which stated 6- 10 weeks duration. In addition, as the patient was amputated because of dysvascular problems, she gained benefit of not being in prolonged immobilization

that could lead to another complication of peripheral vascular disease.<sup>2,9</sup>

The patients had therapeutic exercise for six months, such as range of motion exercise and positioning to prevent development of knee flexion contracture, which often happens in the transtibial amputation. Contractures are preventable through a postoperative therapy program that emphasizes range of motion exercises and early mobilization.<sup>2,10,11</sup>

The strengthening exercise prescribed to this patient was for knee extensor, hip extensor, hip abductor and adductor muscles (right/left). Strengthening of muscle groups that biomechanically substitute for the lost function of the limb is needed. In the individual with a lower extremity amputation, the hip extensors (gluteus maximus and hamstrings), gluteus medius, hip flexors, and the contralateral ankle plantar flexors all contribute to restore ambulation ability.<sup>2, 12</sup>

Seven months after gait analysis, the patient had muscles atrophy in the residual limb. She reported it as loose feeling in the socket since 3 months earlier. Even though she reported good amount of daily activities, she did not come to Physical Medicine and Rehabilitation clinic for the exercise programs. We concluded that the patient did not have enough strengthening exercise which causing atrophy in the residual limb. Comfortable feeling when walking and psychological confidence gained after successful gait analysis made her forgot to routinely visit the gym.<sup>13</sup>

Fatigue was another complaint that could be related to high energy consumption while she was walking using BK prosthesis. As a side note, vascular BK amputation will increase metabolic cost until 40% rather than traumatic BK for about 15%. The Physical Medicine and Rehabilitation program prescriptions to compensate this situation were endurance exercise using arm crank and breathing exercise to improve cardiovascular status. The decision to use endo-skeletal shank also

contributed to the weight reduction of the prosthesis.<sup>14, 15</sup>

There was no report about component damage after one year of BK prosthesis usage. However, it was noted that the prosthesis had 3 revisions on the socket due to skin problems and evolution of the stump shape from cylindrical into conical shape.

After fitting of prosthesis and gaittraining using prosthesis, it is important to evaluate gait in the Gait Laboratory. By using video recording and computer precision, we could gather information such as ground reaction force, step and stride length, joint motion, posture and comparison of both sides. Thus, the data helped us to solve the patient's complaint in walking by using the prosthetic leg.<sup>16</sup>

It was also important to listen to the patient's complaint about contralateral leg, especially in the case of dysvascular amputation. Feeling about numbness and aching in the sound foot after long walking led us to careful examination and found out signs of varicose, decreased O<sub>2</sub> saturation in the foot and 0,92 ABI. Those were signs of peripheral arterial disease. After intervention from cardiologist and vascular surgeon, the complaints diminished, peripheral O<sub>2</sub> saturation become 95-99%.<sup>2</sup>

The presentation of arterial occlusive disease varies with the time course of progression; the presence and extent of collateral vessels; comorbidities; and activity of the patient. Patients with peripheral arterial occlusive disease commonly presented with symptoms of intermittent claudication or critical leg ischemia. If the patient is active, intermittent claudication is the typical presenting complaint. If the patient is inactive, rest pain, ulceration, dependent rubor, or gangrene may be the presenting finding. In general, symptoms will occur distal to the level of stenosis. Intermittent claudication indicates an inadequate supply of arterial blood to contracting muscles. It occurs primarily in chronic arterial occlusive disease or severe arteriospastic disease. Intermittent claudication is brought on by continuous exercise and relieved promptly by rest without

change of the affected limb position. Patients describe claudication as leg numbness, weakness, buckling, aching, cramping, or pain. It may change in character as the causative lesions progress. Claudication occurs at a predictable distance or time. When the workload is increased such as in a rapid pace, walking up hills, or walking over rough terrain; the time to claudication decreases. Claudication may worsen over a period of inactivity (e.g., when the patient is hospitalized) but usually returns to baseline with reconditioning. When claudication abruptly increases, ones must be considered is thrombosis *in situ* or an embolic event. Claudication at the arch of the foot suggests occlusion at or above the ankle; claudication at the calf suggests occlusion at or above this region.<sup>2</sup>

Progression of lower extremity arterial occlusive disease may be slow. In patients presenting with intermittent claudication, symptomatic worsening occurs in 15% to 30% over 5 to 10 years following the initial diagnosis. Tissue necrosis or progression to rest pain requiring vascular surgery occurs in 2.7% to 5% of limbs with claudication annually. Amputation is required in 1% per year.<sup>2</sup>

## Conclusion

Rehabilitation programs to the patient with dysvascular amputation at transtibial level showed complexity prompting the need for close attention. The routine Physical Medicine and Rehabilitation should be involved in pre-operative amputation management and after the surgery amputation. The Physical Medicine and Rehabilitation competency ensures modalities, therapeutic exercise and prosthetic management to help people with transtibial amputation achieve better activity in daily life. Patient's compliance and psychological support were also important for successful rehabilitation programs.

Careful examination and collaboration with other specialties could

prevent the occurrence of stenosis of contralateral leg to prevent future ischemia and amputation.

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