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THE EFFECT OF BOTTOM ROCKER SOLE ON KINETIC ENERGY IN TRANSTIBIAL PROSTHESIS USERS

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Abstract

Background : Lower limb amputation with or without the use of a prosthesis has an impact on energy consumption/needs for ambulances. There are studies that say the results of the measurement of energy used in amputated patients, Amputee patients spend more energy during walking than able-bodied persons. It is generally accepted that more proximal amputation is associated with more energy (Goktepe, et al. 2010) The purpose of this study was to determine the effect of the bottom rocker sole on the kinetic energy of transtibial prosthesis users. **Methods:** This type of research is quasi-experimental with a pre and post-test design approach. This research was conducted at APOC Clinic in April - July 2021, with the research subjects being 20 users of the transtibial prosthesis. Each research subject will be given an intervention in the form of a bottom rocker sole, then measured for kinetic energy before and after treatment. Analysis of the data in this study using the Wilcoxon test. **Results:** There is a statistically significant effect of the use of the bottom rocker sole on the kinetic energy of the transtibial prosthesis users (z = -2.73, mean difference 1.5 and p value = 0.006) **Conclusion:** The use of bottom rocker sole can increase the occurrence of kinetic energy in transtibial prosthesis users so that they can maximize their activities.

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Introduction

Daily functional activities are supported by the four extremities, including the feet. Feet are organs of movement that have an important role in carrying out activities. These activities include standing, walking, running, changing places and other functional activities. When you lose a leg due to amputation, your activities are disrupted. Humans will find it difficult to carry out activities independently so most need the help of others (Pratama, 2018).

So someone who is amputated needs a replacement member that is able to replace the missing limb such as a prosthesis. Where the role of the prosthesis is to replace lost limbs and replace limbs according to lost or amputated limbs (Jeans et al, 2011). In a study it was found that motion and energy greatly affect the activities of daily human life with the motion of objects we can easily do work and by having energy we can do various activities from light to heavy. In everyday observations, motion and energy appear in various forms of energy and motion of objects, such as: the motion of objects rolling, falling and flowing and so on, as well as forms of energy such as chemical, electrical, kinetic energy and so on (Firdaus & Mukhlisah, 2018).

Lower limb amputation with or without the use of a prosthesis has an impact on energy consumption/needs for ambulances. There are studies that say the results of the measurement of energy used in amputated patients, Amputee patients spend more energy during walking than able-bodied persons. It is generally accepted that more proximal amputation is associated with more energy (Goktepe, et al. 2010). In the use of prosthesis, of course, in activities, one of them is shoes. Apart from the prosthesis element that affects the use of energy for walking, the use of these shoes also supports various kinds of prosthesis user activities which are certainly related to the energy used in walking (Jeans et al, 2011). One part of the shoe that can be modified is the shoe sole. Shoe modifications that can be made are modifications to the out sole in the form of a rocker bottom sole design which is expected to be able to provide convenience in stepping, especially in the heel strike and push off phases so that it can have an impact on energy use when walking using a transtibial prosthesis.

Rocker sole shoes or bottom rocker sole shoes are shoes that have thicker soles than usual with rounded heels. Such shoes ensure that the wearer does not have a flat footing along the proximal-distal axis of the foot. The shoe is commonly known by a variety of names including round bottom shoe, round/ed soles shoe, and toning shoe, but also by various brand names. Tyrell & Carter identified at least six variations of the standard rocker sole shoe and named them: toe-only rocker, rocker bar, mild rocker, heel to toe rocker, negative heel rocker and double rocker (Gargiulo, 2017)

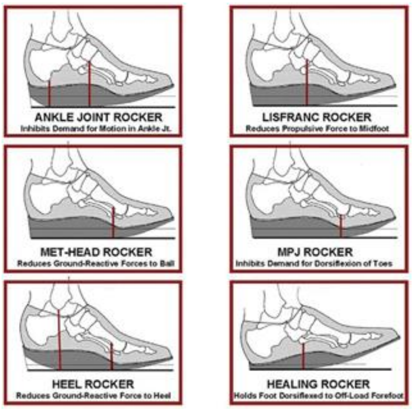

Figure 1. Design *Bottom Rocker Sole*

The purpose of this study was to determine the effect of the bottom rocker sole on the kinetic energy of transtibial prosthesis users.

Methods

This type of research is quasi-experimental with a pre and post test design approach. This research was conducted at APOC

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Clinic in April - July 2021, with the research subjects being 20 users of the transtibial prosthesis. The variables in this study consisted of the independent variable, namely the use of the bottom rocker sole and the dependent variable, namely kinetic energy. Each research subject will be given an intervention in the form of a bottom rocker sole, then measured for kinetic energy before and after treatment. The instrument used in this study was a 10 meter walk test. Measurement of the value of kinetic energy using the formula KE = $^1/_2\ m \times v^2$, where the elements that are calculated are body weight measurements and walking speed. Analysis of the data in this study using the Wilcoxon test.

Results

The characteristics of continuous data research subjects in this study included age, BMI, time, speed, and kinetic energy both before and after treatment. The results of descriptive statistics on the characteristics of continuous data research subjects can be seen in Table 1 as follows:

Table 1. Characteristics of Continuous Data Subjects

Variabel	N	Min.	Max.	Mean	Std. Dev
Age	20	27,00	56,00	41,85	10,78
BMI	20	18,11	31,05	23,51	3,50
Time Pretest	20	8,74	11,69	9,90	0,89
KE. Pretest	20	19,70	47,17	31,26	7,66
Time Postest	20	8,57	11,34	9,69	0,83
KE.Postest	20	22,16	55,37	32,76	9,11
Speed Pretest	20	0,86	1,14	1,02	0,09
Speed Postest	20	0,88	1,17	1,04	0,09

Source : Research data 2021

The results of descriptive statistics on the characteristics of continuous data research subjects show that the average value for age is 41.85 where at this age is the productive age, the average BMI is 23.51 which is included in the ideal category, for the average value of travel time before intervention was 9.90 seconds, time after intervention was reduced to 9.69 seconds, kinetic energy before intervention was 31.26 and after intervention increased to 32.76. Measurement of the value of kinetic energy using the formula KE = $^1/_2\ m \times v^2$ Meanwhile, the speed before the intervention was 1.02 and after the intervention increased to 1.04.

Characteristics of research subjects categorical data in this study is gender. The results of descriptive statistics on the characteristics of categorical data research subjects can be seen in Table 2 are as follows:

Table 2. Characteristics of Categorical Data Subjects

Gender	F	Percentage (%)
Man	14	70
Women	6	30
Total	20	100

Source : Research data 2021

The results of descriptive statistics on the characteristics of categorical data subjects showed that of the total research subjects, there were 20 users of transtibial prostheses, the majority of whom were male, as many as 14 people (70.0%).

The normality test used was the Shapiro Wilk test because the sample in this study was included in the small sample (< 50). The purpose of the normality test is to find out what statistics will be used in data analysis, whether the type of statistic is parametric or non-parametric. The results of the data normality test can be seen in Table 3 as follows:

Table 3. Shapiro Wilk test

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Variable	P Value	α	Description
Pre - KE	0,031	0,05	Not normal
Post -KE	0,010		Not normal

Source : Research data 2021

The results of the normality test with the Shapiro Wilk test showed that the kinetic energy variables before and after treatment showed that the data were not normally distributed, so that the Wilcoxon test used nonparametric statistics.

Testing the hypothesis of the effect of the bottom rocker sole on the kinetic energy of users of the transtibial prosthesis and the data is not normally distributed so that the Wilcoxon test is used. The Wilcoxon test results can be seen in Table 4 as follows:

Table 4. Wilcoxon test

Variable	Mean	Z	P Value
Pre – KE	31,26	-2,73	0,006
Post -KE	32,76		

Source : Research data 2021

The results of the Wilcoxon test on kinetic energy obtained a z value of -2.73 with a mean before and after treatment an increase of 1.5 and a p value of 0.006 where p-value <0.05, it can be concluded that there is a difference in kinetic energy before and after the intervention which significantly statistically significant.

Discussion

Research entitled the effect of the bottom rocker sole on kinetic energy in transtibial prosthesis users showed that there was a statistically significant difference in kinetic energy before and after the intervention. (z = -2.73, mean difference 1.5 and p value = 0.006). This means that the more frequently you use the bottom rocker sole, it can increase the value of its kinetic energy. This is supported by research from Goktepe, et all (2010) which states that the energy used in amputee patients, namely walking on a partially amputated leg, will expend more energy than an amputee. Many result in fatigue one level above the fatigue felt in normal people.

A transtibial prosthesis is an artificial limb that replaces a missing leg below the knee. A transtibial amputation is usually able to regain normal motion more easily than someone with a transfemoral amputation, because it largely preserves the knee, which allows easier movement. Lower extremity prosthesis describes an artificially replaced limb located at hip level or lower (Lusardi et al, 2013). In their activities, prosthesis users certainly need energy to walk, so to minimize energy consumption so they don't get tired quickly, it is necessary to modify the shoes of transtibial prosthesis users, one of which is a modification to the shoe sole in the form of a bottom rocker sole.

The rocker bottom sole is the bottom of the shoe that has a thicker sole than normal with a rounded heel. A user of a transtibial prosthesis requires greater kinetic energy than a normal person when walking. One of the benefits of using a rocker bottom sole is that it can reduce the need for kinetic energy when walking (Scott et al, 2013). The bottom rocker sole on the transtibial prosthesis is a kind of modification that can be done in the form of giving a curved shape to the forefoot of the shoe or the heel of the shoe that will be used by users of the transtibial prosthesis, where in principle by forming the bottom rocker sole it can make it easier for transtibial prosthesis users to carry out this phase. push off to then become the swing phase in walking.

Kinetic energy is also known as energy of motion. Where when experiencing movement, the energy that we will spend is kinetic energy. Examples of kinetic energy that are usually done in daily life include mothers cooking in the

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kitchen, someone walking or running, moving cars and motorbikes, and several other examples (Ardiyanto, 2019). According to Peasgood in Rahmadi, amputee walking activities with prosthesis are certainly different from normal people. In maintaining stability without active ankle or knee joint control, the amputee makes a change from the normal kinematic gait pattern observed by Czerniecki. During standing, there is no knee flexion of about 30-40% at the beginning of the standing phase, to avoid bending the knee. Entering the swing phase, the amputee must balance the lock of gastrocnemius and foot muscles in the ankle region by increasing the hip flexor force, despite the relative decrease in mass of the normal limb limb prosthesis.

Conclusion and Recommendation

A study entitled the effect of the bottom rocker sole on kinetic energy in transtibial prosthesis users which was carried out at the APOC Boyolali Clinic in April - July 2021 concluded that there was a statistically significant difference in kinetic energy before and after the intervention. This means that using the bottom rocker sole can increase kinetic energy when walking so that it can also help transtibial prosthesis users in carrying out moving activities, one of which is walking so they don't get tired easily.

The results of this study are expected to provide a suggestion for the provision of services to transtibial prosthesis users so that it is easier and not tire quickly in carrying out activities by providing a bottom rocker sole on their shoes as well as providing a good and appropriate transtibial prosthesis according to patient needs.

References

Ardianto, 2019, Rumus.co.id, Diakses 27 Juni 2019 Dari https://rumus.co.id/energi-kinetik/

Firdaus,F., Mukhlisah,S., 2018, Gerak Benda Dan Konsep Energi Mekanik, Universitas Muhammadiyah, Sidoarjo, hal.7-13.

Göktepe AS, Cakir B, Yilmaz B, Yazicioglu K. Energy Expenditure of Walking with Prostheses: Comparison of Three Amputation Levels. Prosthetics and Orthotics International. 2010;34(1):31-36. doi:10.3109/03093640903433928

Hasbiyati, H. (2012). PEMBENTUKAN ENERGI DALAM TUBUH MANUSIA (keterkaitan ilmu Biologi dan Fisika).JURNAL BIOSHEELL, 1(1).

Jeans, Kelly A. MS1; Browne, Richard H. PhD1; Karol, Lori A. MD1. Effect of Amputation Level on Energy Expenditure During Overground Walking by Children with an Amputation. The Journal of Bone & Joint Surgery: January 5, 2011 - Volume 93 - Issue 1 - p 49-56 doi: 10.2106/JBJS.I.01557

Lusardi, M. M., Jorge, M., & Nielsen, C. C. (2013). *Orthotics and prosthetics in rehabilitation-e-book*. Elsevier Health Sciences.

Lusardi, M. (2013). Principles of lower extremity orthoses. *Orthotics and Prosthetics in Rehabilitation*, 219-265.

Niu, H. X., Wang, R. H., Xu, H. L., Song, B., Yang, J., Shi, C. H., ... & Xu, Y. M. (2017). Nine-hole peg test and ten-meter walk test for evaluating functional loss in Chinese charcot-marie-tooth disease. Chinese medical journal,130(15), 1773-1778.

ISSN 2962-8016

Pratama, A. D. (2018). Penatalaksanaan Fisioterapi pada Kasus Post Amputasi Transtibial Sinistra Akibat Chronic Limb Ischemia di RSPAD Gatot Soebroto. *Jurnal Vokasi Indonesia*, *6*(2), 33-40.

Santo, Antonio S.; Roper, Jenevieve L.; Dufek, Janet S.; Mercer, John A.. Rocker-Bottom, Profile-Type Shoes Do Not Increase Lower Extremity Muscle Activity or Energy Cost of Walking. Journal of Strength and Conditioning Research: September 2012 - Volume 26 - Issue 9 - p 2426-2431 doi: 10.1519/JSC.0b013e31823f8b71

Sardjito, S., Yuningsih, N., & Hadiningrum, K. (2014). KONSUMSI ENERGI MEKANIK GERAK LANGKAH TUBUH MANUSIA SAAT BERJALAN. *Sigma-Mu*, *6*(2), 1-7.

ISSN 2962-8016
9 772962 801001