

Comparison of Energy Expenditure of a Geriatric Amputee with a Normal Abled Bodied Subject during Prosthetic Rehabilitation with Bilateral Lower Extremity Amputations - A Case Report

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ABSTRACT

Background: Bilateral Transfemoral (TF) amputations are a major barrier to walking because patients no longer have direct muscular control of their both knees. Moreover, the high energy expenditure (EE) makes ambulation impractical for patients with bilateral TF amputations, especially for the elderly with dysvascular amputations.

Aim: The aim of this study is to quantify and to compare the energy expenditure during different level of walking (plane surface, stair and ramp) in a bilateral amputee having Right side TF amputation and Left side Transtibial amputation with 90 degree flexion contracture with a Normal Abled body Subject.

Methods: A patient of 62 year old having Right side TF amputation and Left side Transtibial amputation with flexion contracture is fitted with stubbies prosthesis with rocker. Energy expenditure was measured in terms of oxygen uptake, oxygen cost and heart rate by using COSMED K4 b² metabolic analyzer.

Results: The client can able to walk with the support of a walking stick. The result of the present case report shows that no doubt there is a more energy expenditure in all the level of surfaces compared to the normal subject however there is no such difference with our client because of the activeness of the client.

Conclusion: Though walking with stubbies prosthesis requires high energy expenditure, But the client was able to move in various level of walking with greatest confidence and less fear of falling. However the Prosthetist should consider about the light weight phenomenon for less energy conservation.

Clinical relevance: This case report gives an objective prescription of Stubbies prosthesis especially for geriatric population in case of bilateral Transfemoral amputations and provides a kind of inspiration to Bilateral Amputees.

Keywords: Energy Expenditure, Geriatric Amputee, Transfemoral Amputation, Stubbies Prosthesis.

INTRODUCTION

Seventy five percent of all lower extremity amputations occur in people aged 65 or older [1] and also It is well recognized that that persons with lower extremity Amputation who walk with prosthetic devices have greater Energy requirements to

travel a given distance than do Able-bodied Individuals during normal walking. [2] It has also been demonstrated that persons with higher level unilateral and bilateral Amputation require greater energy than do those with lower Level unilateral amputation. [3-5] Moreover, the high energy

expenditure (EE) makes ambulation impractical for patients with bilateral amputations, especially for the elderly with dysvascular or Traumatic amputations. [6] If the amputation level is higher like at the Transfemoral level, the client may choose a short prosthesis like stubbies prosthesis.

Stubby prostheses (also referred to as “stubbies”) are short non-articulated pylon prosthetic devices which have been suggested as an alternative to full-length articulated prostheses in bilateral Transfemoral amputee patients, particularly in the more elderly patient population. Previous advocates of stubbies [7] have stressed the following advantages related to their use: (1) lowered height and center of gravity, improving safety and reducing the danger of serious falls; and (2) eliminated prosthetic knee joint, improving patient stability. The main objective of the study is to quantify and to compare the energy expenditure during different level of walking (plane surface, stair and ramp) in a bilateral amputee having Right side TF amputation and Left side Transtibial amputation with flexion contracture using stubbies prosthesis with a Normal Abled body Subject.

MATERIALS AND METHODS

Subject - The subject was a 63-year-old man, a victim of a traffic mishap who sustained traumatic injury to her legs and received bilateral amputations i.e having Right side TF amputation and Left side Transtibial amputation with 90 degree

flexion contracture . He was transferred to our institute for replacement of the prosthesis as the old prosthesis had already broken. Physical examination at admission revealed the right stump length below the ischial tuberosity was 33cm and the left from mid-patellar tendon level was 30.3cm. The man’s body weight and height was 65kg and 160cm, respectively, and he was in good health before with the older prosthesis. There were no such clinical findings on both the stump except some scar marks at the distal aspect of the stump. The client was using a stubbies prosthesis i.e. a Transfemoral type prosthesis on the right side and bend knee type prosthesis on the left side with hip joint thigh joint suspension. The old man was using a walking stick for support. As per the older prosthesis we also had given a same type of prosthesis as the client was well experienced with the older prosthesis. The EE of prosthetic walking was evaluated by Cosmed k4b2 metabolic analyzer system (COSMED Srl – Italy) for the measurement of O₂ uptake (ml/min/Kg), oxygen cost (ml/Kg/m) and heart rate (Beats per minute) after 2 weeks of training at different levels with the walking stick (Fig.1&2). Similarly the energy expenditure was measured in able-bodied subjects with same age and same body weight. The researchers and the subject agreed that she was accustomed to using the prostheses and walking devices and that he could walk continuously in a stable speed for more than 8 minutes before proceeding with each test.

Cosmed k4b2 metabolic analyzer system -: (Fig -3)



Fig 1 – Patient walking on the stair, Fig 2 – Patient walking on the level surface
Fig 3 - K4b2 System (Respiratory Analyzer System COSMED ® K4 b² (Cosmed-spl-Italy))

The K4 b2 utilizes digital telemetry transmission to send breath by breath data to the PC located away from the subject (up to 800 meters). During transmissions K4 b2 stores data into its memory to avoid any possible data lost.

RESULT

Result of this case report was analyzed with comparison of the client's parameters with normal-abled subject parameters. The results of oxygen uptake, oxygen cost, and HR are summarized in Table 1. The result of the present case report shows that no doubt there is a more energy expenditure in all the level of surfaces compared to the normal subject however there is no such difference with our client because of the activeness of the client. In case of ramp and stair, the oxygen uptake is 28% and 25% more compared to the normal subject. Similarly oxygen cost in case of client in level surfaces, ramp and stair is 39%, 36% and 14% more than the Normal abled subject. In the same manner heart rate is also increasing.

Table - 1

TEST	OXYGEN UPTAKE (ML /KG/ MIN)		OXYGEN COST (ML/KG/M)		HEART RATE (BEATS/MIN)	
	Client	Normal Subject	Client	Normal Subject	Client	Normal Subject
ON LEVEL SURFACE	20.04	14.02	1.240	0.761	146	136
ON RAMP	22.63	16.42	1.796	1.166	153	147
ON STAIR	25.42	19.21	2.153	1.865	168	159

DISCUSSION

The human body has evolved an efficient locomotor system and any deviations from normal gait pattern increase the energy cost of walking. The oxygen cost, which is the required energy to complete a task, negatively correlated with "gait efficiency." Therefore, oxygen cost while walking is much higher for people with amputation than for able-bodied persons. Our subject's Oxygen uptake was 20.04 on level surface, 22.63 on ramp and 25.42 ml/kg/min on stair and his oxygen cost was 1.240, 1.796 and 2.153 ml/kg/m while walking with prostheses and walking aids. The oxygen uptake and oxygen cost of able-bodied subjects during comfortable speed walking are 14.02, 16.42, 19.21 ml/kg/min and 0.761, 1.166, 1.865 ml/kg/m respectively. The EE of level walking of people with amputation is affected by their muscle strength, mechanical properties of the prostheses and walking devices, and their familiarity with the prostheses. [8,9,10] Though there are limited no of research comparing different level terrain however Yi-Jane Wu et al [11] reported same result in level surfaces. Isakov et al [12] found that both the oxygen cost and HR were

considerably higher when subjects walked with unlocked-knee TF prosthesis than stubbies prosthesis which shows stubbies prosthesis will be a better prescription.

CONCLUSION

Prosthesis fitment is always challenging in case higher level amputations. Proper training and various physiotherapy modalities like muscle strengthening will definitely bring out a good outcome. The prime aim of the Prosthetist is to increase the confidence level of the client. The study regarding Energy expenditure reveals that it mimics to a normal geriatric individual. The satisfaction levels of the old man as well as his son are also so high which gives us a lot of happiness.

Conflict of Interest –

The author does not have any conflict of interest regarding research, authorship and publication of this article.

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