Research Paper:

Effect of Walking Speed on Gait Parameters and Energy Expenditure in Individuals with Unilateral Trans-tibial Amputation

Sangeeta Patra[1], Rajesh Kumar Mohanty[1*], Sakti Prasad Das[2]

1. MPO Section, Department of Prosthetics and Orthotics, Swami Vivekanand National Institute of Rehabilitation Training and Research, Cuttack, Odisha, India.
2. Department of Physical Medicine and Rehabilitation, Swami Vivekanand National Institute of Rehabilitation Training and Research, Cuttack, Odisha, India.

Article info:
Received: 21 Sep 2021
Accepted: 09 Nov 2021
Available Online: 30 Dec 2021

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Conflict of interest

The authors declared no conflict of interest.

ABSTRACT

Background and Objectives: Analysis of gait parameters and energy expenditure in different walking speeds in trans-tibial amputees has been less investigated. This may provide an insight into how they respond to it. The main aim of this study was to investigate the effect of walking speed changes on gait parameters and metabolic energy consumption in unilateral trans-tibial amputees using the prosthesis.

Methods: Thirty trans-tibial amputees fulfilling inclusion criteria were investigated for gait parameters using a ten-meter walk test while these subjects walked with three different walking speeds (comfortable, fast, and slow). Temporal-spatial gait parameters, such as step length, stride length, velocity and cadence, and Physiological Cost Index (PCI) for metabolic energy consumption were analyzed by repeated-measures ANOVA.

Results: Step length of a prosthetic side in the fast walking speed (0.67±0.10 m) was higher than the normal comfortable speed (0.56±0.13 m) and least in slow walking (0.42±0.06 m). A similar trend was observed for all gait parameters. PCI (beats/m) was least in normal comfortable speed (0.08±0.09), followed by fast walking speed (0.11±0.08). It was highest when patients walked at a slow speed (0.18±0.12). There was a significant difference in all temporal-spatial gait parameters and PCI in three walking speed conditions ($P<0.05$).

Conclusion: Walking speed significantly affected all temporal-spatial and energy parameters in unilateral trans-tibial amputees.

Keywords: Gait parameters, Physiological Cost Index, Transtibial, Walking speed

Use your device to scan and read the article online

Cite this article as Patra S, Mohanty RK, Prasad Das S. Effect of Walking Speed on Gait Parameters and Energy Expenditure in Individuals with Unilateral Trans-tibial Amputation. Function and Disability Journal. 2021; 4:E41. http://dx.doi.org/10.32598/fdj.4.41

http://dx.doi.org/10.32598/fdj.4.41

*** Corresponding Author:**
Rajesh Kumar Mohanty, PhD Scholar.
Address: *MPO Section, Department of Prosthetics and Orthotics, Swami Vivekanand National Institute of Rehabilitation Training and Research, Cuttack, Odisha, India.*
Tel: *+91 (700) 8960993*
E-mail: *rajeshmpo48@gmail.com*

What is "already known" in this topic:

Effect of Walking Speed on Gait Parameters and Energy Expenditure

What this article adds:

In addition to quantifying the temporal-spatial parameters and metabolic cost of unilateral transtibial amputee gait with walking speed changes, this study provided an insight into any association between the observed parameters.

Introduction

Transtibial Amputation (TTA) involves amputation through the tibia, loss of ankle joint, and partial loss of lower extremity muscle groups that presents considerable challenges to the amputees during gait and other activities of daily living. TTA is the second most common type of amputation primarily due to traumatic injuries and vascular diseases. It is a well-known fact that walking speed is reduced in TTA compared to healthy subjects and is significantly decreased at higher levels of amputation. TTA results in much asymmetry due to the functional loss of the ankle plantar flexors, which have been shown to be critical in providing body support, forward propulsion, and leg swing initiation during normal walking [1]. Therefore, efforts in the rehabilitation of amputees are directed at the construction of a prosthesis, which provides normal leg function and allows a more symmetrical gait. The sound leg has to compensate for the other side, which creates asymmetry with regards to shortened stance duration and vertical and horizontal ground reaction forces on the prosthetic limb [2].

In addition to specific walking speeds, circumstances and environmental conditions cause alterations in velocity. An amputee with community ambulation may require walking at a range of speeds in order to perform certain activities, such as crossing a street, catching a bus, or keeping up with peers [3]. However, two important parameters, such as an increase in energy expenditure and reduction in walking speeds may impede the ability of individuals using trans-tibial prostheses to participate in chosen activities. It has been observed that with increasing walking speed, temporal gait variables are reduced, particularly on the prosthetic limb, while vertical ground reaction force is increased in magnitude for the intact limb [4]. Limited data exist on the effect of walking speed on gait asymmetry and energy expenditure. Total energy consumption during walking in traumatic TTA is 25 percent higher and their movement speed is lower by 13 percent compared to the normal population [5].

In literature, the studies conducted on walking speed and its effects in unilateral TTA are lacking. investigation of the effects of walking speed on minimum toe clearance (kinematics) and the temporal relationship between minimum clearance and peak swing-foot velocity in unilateral TTA using advanced prosthetic feet. Minimum toe clearance was reduced on the prosthetic side and did not increase with the walking speed increase. Peak swing-foot velocity consistently occurred after the point of minimum toe clearance on both limbs across all walking speeds [6]. Some studies have investigated the effect of walking speed changes on the metabolic energy in traumatic unilateral TTA [5, 7-10, 11]. However, conflicting results have been observed by earlier researchers on the association between walking velocities and energetic gait. Christine et al. observed that the energy cost of gait increases at lower speeds and vice versa [7]. In contrast, Sokhangoei et al. concluded that by increasing the speed, the walking energy costs in the amputee group intensifies [5]. Limited studies have investigated the effects of alteration of walking speed on gait parameters in unilateral TTA [10, 12]. There is only one study, which has evaluated the effects on gait parameters and energy expenditure by altering walking speed (slow, fast, and self-selected) in subjects with TTA [10].

The results showed significant changes in the gait parameter, which indicates that the amputee's gait is not normalized in various walking speeds. The investigators reported a minimum value of PCI indicating better gait efficiency at higher walking speed during the initial period of walking. Therefore the intent of this study was to assess whether there is any change in temporal-spatial parameters and energy expenditure in unilateral TTA wearing prostheses that walked with fast, slow, and com-

Figure 1. (a) Residual limb and prosthetic system; (b) Oxymeter used for PCI measurement

fortable speed. Secondly, the objective was also to investigate the effect of walking speed changes on metabolic energy consumption. The prosthesis used in this study was modular in design with a PTB socket, Ranger foot (solid ankle), and cuff suspension. The prosthetic components used in this study were confined as there is evidence describing the influence of prosthetic components on gait parameters among this population [13]. It was hypothesized that there could be significant differences in gait parameters and energy consumption in unilateral TTA using prosthesis while walking at different speeds. Manipulating walking speed could give a valuable insight into how amputees respond to different physical demands made on them, such as increased or decreased walking speed. This study also focused on whether the amputees get exhausted or face any other complications while walking at different speeds. This will encourage the prosthetist whether to suggest amputees vary walking speeds during normal activities.

Methods

Study population

Thirty subjects of either sex with unilateral TTA using prosthesis for at least the past three months [14] were

Figure 2. Performance in 10 m walk test

a: Right prosthesis; b: Left prosthesis.

Figure 3. Foot impression

(a) Foot Impression; (b) Measurement of Gait Parameters during 10 m walk test

recruited as per the inclusion and exclusion criteria. The inclusion criteria were a minimum residual limb length of four inches from the medial tibial plateau, [13, 15] no contracture on the proximal joints, and good muscle strength and range of motion around the knee. Subjects with other associated neurological or orthopedic conditions, complicated stump (pain, wound, etc.), or significant pathology in cardiopulmonary status were excluded.

Study tools and instrumentation

A 10-meter walk test [16] was performed for temporal-spatial gait parameters (stride length, step length, velocity, and cadence) and an Oximeter (Figure 1b) was used to calculate the physiological cost index (PCI) [17].

Study procedure and protocol

After initial screening and obtaining demographic information, the subjects were instructed to walk with a prosthesis (Figure 1a) on a 10-meter walk test paper (Figure 2) with three different walking speeds (customary, fast, and slow) in standard environmental conditions. The walking sequence was randomized and a repeated measure experimental study design was used for the clinical data recording. A pause or rest period of five minutes was given to maintain heart rate to come to a baseline level in between three trials [18]. Intervention data regarding different parameters were collected by measuring with steel rule or cloth tape measure (Figure 3) whereas data on metabolic energy expenditure was collected through a digital Oximeter. Then, the data were analyzed and compared among three walking conditions.

Ethical approval

The participants received oral and written information and gave their written informed consent. The study was approved by the ethical committee of Swami Vivekananda National Institute of Rehabilitation Training and Research, Cuttack.

Data analysis

Data were managed on an excel spreadsheet. IBM SPSS 23.0 was used for data analysis. A repeated-measures ANOVA was used to compare temporal-spatial gait parameters and PCI in three walking conditions (normal, fast, and slow). A post hoc test was performed to explore which particular differences between pairs of means are significant. The significance level of $P<0.05$ was fixed. Effect size (d) was also calculated to quantify the amount of effect that walking speed has on gait parameters and energy expenditure, with $d<0.2$ considered very small effect size, $0.5>d=>0.2$ a small effect size, $0.5<d<0.8$ a medium effect size, and $d>0.8$ considered large effect size.

Results

The anthropomorphic and demographic data of the subjects were recorded and presented in Table 1. There were 18 male and 12 female subjects. With reference to the side of amputation, there were 16 subjects with right and 14 subjects with left trans-tibial amputation.

The temporal-spatial gait variables are shown in Table 2. It contains the means and standard deviations of the mea-

Table 1. Demographic data of the subjects

Demographic Parameters	Mean±SD
Age (y)	45.7±12.6
Weight (Kg)	63.5±7.8
Height (cm)	154.6±10.3
Time since amputation (y)	6.7±3.1
Time since using the current prosthesis (y)	2.5±1.4

Table 2. Comparison of the measured gait parameters and Physiological Cost Index (PCI)

Walking Condition	Mean±SD					
	Step Length (N) (m)	Step Length (P) (m)	Stride Length (m)	Velocity (m/min)	Cadence (Steps/Min)	PCI (Beats/Meter)
Normal	0.65±0.13	0.56±0.13	1.01±0.32	45.5±24.1	91.7±41.5	0.08±0.09
Fast	0.74±0.12	0.67±0.10	1.31±0.22	67.0±28.4	110.7±43.6	0.11±0.08
Slow	0.49±0.12	0.42±0.06	0.84±0.18	27.4±8.0	69.2±18.6	0.18±0.12

surements of step length (normal), step length (prosthetic), stride length, cadence, velocity, PCI. Results of this study indicated that the step length (m) of the prosthetic side in the fast walking speed (0.67±0.10) was higher than the normal comfortable speed (0.56±0.13) and least in slow walking (0.42±0.06). Similarly, the stride length (m) performed in the fast gait trial (1.31±0.22) was also higher than the normal comfortable speed (1.01±0.32) and least in slow speed (0.84±0.18). Cadence (steps/min) significantly increased in fast speed (110.7±43.6) followed by normal comfortable speed (91.7±41.5) and then in slow speed (69.2±18.6). The velocity ranged from fast (67.0±28.4) to normal (45.5±24.1) and slow speed (27.4±8.0). PCI was least in normal comfortable speed (0.08±0.09), followed by fast walking speed (0.11±0.08). It was highest when patients walked at a slow speed (0.18±0.12). There were significant differences observed in gait parameters and PCI values across all speeds ($P<0.05$). After obtaining significant F statistics, post-hoc analysis indicated that differences between all parameters were significant at all speeds ($P<0.05$); however, the effect sizes were medium ($0.5< d <0.8$).

Discussion

The intention of this study was to investigate the effect of walking speed changes on gait parameters and metabolic energy consumption in unilateral TTA. It was observed that with the walking speed changes, each of the discussed gait parameters (step length, stride length, cadence) and energy expenditure (PCI) meaningfully changed. It is known that the instantaneous speed varies from one instant to another during the walking cycle, but the average speed is the product of the cadence and the stride length.

Effect of walking speed changes on Temporal-spatial gait parameters

In our study, each of the gait parameters increased significantly in fast, and then gradually decreased in normal and slow speed, respectively. Step length was less at slow speed followed by normal and fast walking speed. These results are in accordance with earlier research by Majumdar et al. (2008) who observed that step time parameters, including single support time, single swing time, and step length significantly reduced with the speed diminution while double support in both limb and step duration in prosthetic limb augmented [10]. The ground reaction force patterns were moreover similar in different walking speeds; however, there was a significant difference in the force amplitude and rate of increment with slower to a higher speed. In another study, Isakov et al. (1996) performed gait analysis of unilateral TTA while ambulating at their own freely selected speed and at a faster speed. The faster gait trial affected all temporal and distance parameters in both legs significantly. The step

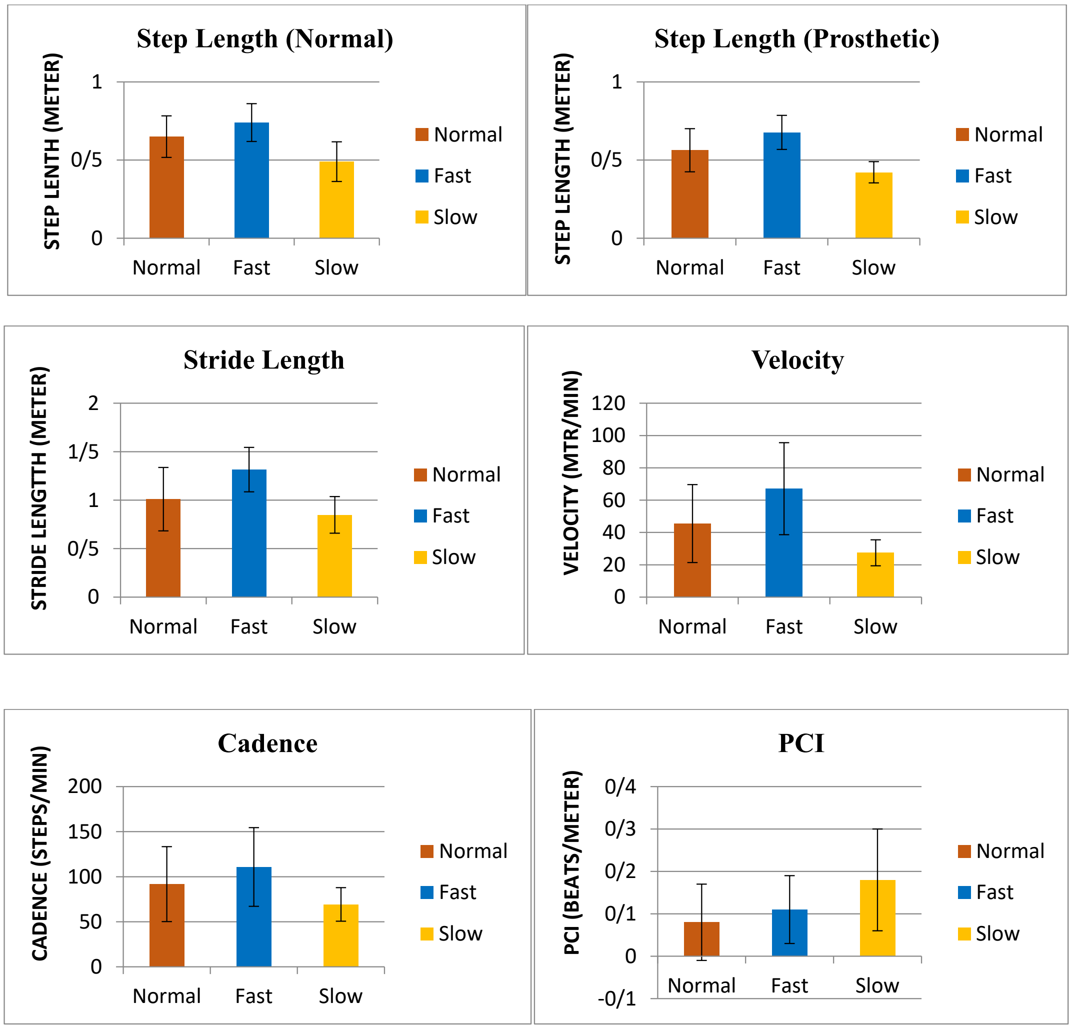

Figure 4. Graphical comparison of measured gait parameters and Physiological Cost Index (PCI)

length, stride length, cadence, and velocity all increased by increasing the gait speed [11]. Sanderson et al. (1997) observed that increase in speed from 1.2 to 1.6 m/s was associated with an expected decline in stride time that indicates an increase in stride rate as speed is increased [19]. The general response to increased walking speed was to increase stride length and rate, increase ground reaction force peaks, and increase the magnitude of net joint moments [12]. These results are also in line with our study. In another study, Nolan et al. (2003) investigated the effects of increased walking speed on temporal and loading asymmetry in highly active TTA [20]. They concluded that with increasing walking speed, temporal gait variables reduced in duration, particularly on the prosthetic limb, while vertical ground reaction force increased in magnitude, especially on the intact limb. For the temporal variables, all amputees were observed to have a longer stance time and shorter swing time on their intact limb compared to their prosthetic limb. All temporal values were observed to decrease with walking speed. For swing and step time duration, the prosthetic limb appeared to be affected more by walking speed, whilst for a stance time duration, the intact limb appeared to be most affected by walking speed [4].

Effect of walking speed changes on energy expenditure

In our study, the energy parameter (PCI) was significantly affected by changing walking speed. PCI was least in normal comfortable speed, followed by fast walking speed and highest in slow speed. However, the amputees did not show any sign of getting exhausted or faced any other complications while walking at different speeds. The results are well supported by Genin et al. (2005) who found that the self-selected speed influenced the energy cost of gait [21]. They observed that the energy cost of gait was much higher at lower speeds and an increase in gait speed in amputees could decrease the energy cost of gait [7]. Similarly, Majumdar et al. (2008) observed that PCI was higher during slow walking speed in subjects with unilateral TTA [5]. They observed no significant difference in PCI in various walking speeds. There is a gradual drop in PCI value with the speed increment, which indicated a better gait efficiency at a higher speed of walking [10].

However, Sokhangoei et al. (1973) concluded that by increasing the speed, the walking energy costs in the amputee group intensify compared to control subjects [3]. The trend is similar in comparison to previous studies but there are only differences in the three walking conditions due to the use of different materials and walking environment. Bastien et al. (2003) observed that energy expenditure rate increases faster with speed than in normal subjects walking [7]. Below the optimal walking speed (1 m/s), TTA does not consume more energy than control subjects. However, when speed increases above 1 m/s, the mass-specific average power becomes significantly greater in the TTA group than in control subjects. As the fastest sustainable speed reached by TTA (1.7 m/s), their power consumption was 20% greater than that of the control subjects [19].

There are some studies, which proved that the use of different prosthetic components has an impact on gait parameters and energy expenditure indices. Gard et al. (2003) in their study revealed significant differences in the temporal-spatial gait parameters and GRF with the addition of the shock-absorbing pylon [8]. Hsu et al. (1999) reported that during both walking and running, the Re-Flex vertical shock pylon significantly reduced energy cost, increased gait efficiency, and decreased exercise intensity compared to the flex-foot or SACH foot [9]. They suggested that the design benefits of the prosthetic mechanisms are speed-dependent and the differences become more apparent at speeds above 1.12 m/s [21]. Bateni et al. (2004) reported that the PCI was greater with steel components than when using titanium for all participants [17]. The results of our study are also in agreement with a recent study conducted by Sibley et al. (2021) who found significant differences between limbs at both speeds (comfortable and fast) for all gait variables (temporal-spatial: $P \leq 0.006$; kinetics $P \leq 0.008$), except single support time during fast walking ($P=0.218$) [22]. Speed of walking during PCI tests tended to be greater when the steel components were replaced with titanium. Hence, in our study, a single set of components were used for all subjects as alteration of components and materials can result in variations in gait parameters and energy expenditure [23, 24].

Clinical implication

This study provided an insight into how amputees respond to different walking speeds and quantified the gait parameters and metabolic cost in different walking speeds. It gave an idea to encourage the patients to walk at normal speed during gait.

Limitation of Study

It is a single-center study. Instrumental gait analysis could not be performed. No training or accommodation period was given for walking at fast and slow speed

Future Scope

The results can reveal the necessity of paying more attention to the anatomical and biomechanical principles in manufacturing the prostheses and the new approaches and components, which decrease the energy needed during walking.

Conclusion

In conclusion, the speed of gait in TTA significantly affected all temporal-spatial as well as energy expenditure. Although the trend is the same, there are differences in mean scores compared to previous studies. Analysis of gait in amputees provided the necessary information or focused research and development on prosthetic components, which can duplicate normal leg functions.

Ethical Considerations

Compliance with ethical guidelines

This research followed the guidelines of the Declaration of Helsinki and was approved by the Institutional Review Board of Swami Vivekanand National Institute of Rehabilitation Training and Research (SVNIRTAR), India.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Authors' contributions

Material preparation, data collection, and analysis: Sangeeta Patra and Rajesh Kumar Mohanty; Investigation, writing – original draft, and writing – review & editing: Rajesh Kumar Mohanty; Final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

References

[1] Silverman AK, Fey NP, Portillo A, Walden JG, Neptune RR. Compensatory mechanisms in below-knee amputee gait in response to increasing steady-state walking speed. Gait Posture. 2008; 28(4):602-9. [DOI:10.1016/j.gaitpost.2008.04.005] [PMID]

[2] Hermodsson Y, Ekdahl C, Persson BM, Roxendal G. Gait in male transtibial amputees: A comparative study with healthy subjects in relation to walking speed. Prosthet Orthot Int. 1994; 18(2):68-77. [DOI:10.3109/03093649409164387] [PMID]

[3] Sokhangoei Y, Abbasabadi A, Akhbari B, Bahadoran M. Investigating the relation of walking speed changes with the metabolic Energy consumption index in traumatic unilateral below knee amputees. Eur J Exp Biol. 2013; 3(3):173-7. https://www.imedpub.com/articles/investigating-the-relation-of-walking-speed-changes-with-the.pdf

[4] Christine D, Vanmarsenilleb JM, De Cuyperc F, Diericka F. Relationship between energy cost, gait speed, vertical displacement of centre of body mass and efficiency of pendulum-like mechanism in unilateral amputee gait. Gait Posture. 2005; 21(3):333-40. [DOI:10.1016/j.gaitpost.2004.04.005] [PMID]

[5] Majumdar K, Lenka PK, Kumar R. Variability of gait parameters of unilateral trans-tibial Amputees in different walking speeds. Indian J Phy Med Rehabil. 2008; 19(2):37-42. Lenka/publication/44886942_Variability_of_Gait_Parameters_of_Unilateral_-Speeds.pdf

[6] Isakov E, Burger H, Krktnm J, Gregoric M, Marincek C. Influence of speed on gait parameters and on symmetry in trans-tibial amputees. Prosthet Orthot Int. 1996; 20(3):153-8. [DOI:10.3109/03093649609164437] [PMID]

[7] Bastien GJ, Willems PA, Schepens B, Heglund NC. Effect of load and speed on the energetic cost of human walking. Eur J Appl Physiol. 2005; 94(1-2):76-83. [DOI:10.1007/s00421-004-1286-z] [PMID]

[8] Gard SA, Konz RJ. The effect of a shock-absorbing pylon on the gait of persons with unilateral transtibial amputation. J Rehabil Res Dev. 2003; 40(2):109-24. [DOI:10.1682/JRRD.2003.03.0109] [PMID]

[9] Hsu MJ, Nielsen DH, Yack HJ, Shurr DG. Physiological measurements of walking and running in people with transtibial amputations with 3 different prostheses. J Orthop Sports Phys Ther. 1999; 29(9):526-33. [DOI:10.2519/jospt.1999.29.9.526] [PMID]

[10] Zidarov D, Swaine B, Gauthier-Gagnon C. Life habits and prosthetic profile of persons with lower-limb amputation during rehabilitation and at 3-month follow-up. Arch Phys Med Rehabil. 2009; 90(11):1953-9. [DOI:10.1016/j.apmr.2009.06.011] [PMID]

[11] Soares AS, Yamaguti EY, Mochizuki L, Amadio AC, Serrão JC. Biomechanical parameters of gait among transtibial amputees: A review. Sao Paulo Med J. 2009; 127(5):302-9. [DOI:10.1590/S1516-31802009000500010] [PMID]

[12] Czerniecki JM, Morgenroth DC. Metabolic energy expenditure of ambulation in lower extremity amputees: What have we learned and what are the next steps? Disabil Rehabil. 2017; 39(2):143-51. [DOI:10.3109/09638288.2015.1095948] [PMID]

[13] McDonald CL, Kramer PA, Morgan SJ, Halsne EG, Cheever SM, Hafner BJ. Energy expenditure in people with transtibial amputation walking with crossover and energy storing prosthetic feet: A randomized within-subject study. Gait Posture. 2018; 62:349-54. [DOI:10.1016/j.gaitpost.2018.03.040] [PMID]

[14] Graser JV, Letsch C & van Hedel HJA. Reliability of timed walking tests and temporo-spatial gait parameters in youths with neurological gait disorders. BMC Neurol. 2016; 16:15. [DOI:10.1186/s12883-016-0538-y] [PMID] [PMCID]

[15] Mohanty RK, Lenka P, Equebal A, Kumar R. Comparison of energy cost in transtibial amputees using "prosthesis" and "crutches without prosthesis" for walking activities. Ann Phys Rehabil Med. 2012; 55(4):252-62. [DOI:10.1016/j.rehab.2012.02.006] [PMID]

[16] Kazi AM, Bhatti A, Malik NA, Soomro N. Transtibial and transfemoral levels of amputation: Effects on prosthetic fitting and locomotion. J Sur Pak. 1999; 4(2):13-6. https://pesquisa.bvsalud.org/portal/resource/pt/emr-51423

[17] Bateni H & Sandra O. Effect of the weight of prosthetic components on the gait of transtibial amputees. J Prosthet Orthot. 2004; 16(4):113-20. [DOI:10.1097/00008526-200410000-00004]

[18] Ito T, Sugiura H, Ito Y, Noritake K, Ochi N. Relationship between the skeletal muscle mass index and physical activity of Japanese children: A cross-sectional, observational study. PLoS One. 2021; 16(5):e0251025. [DOI:10.1371/journal.pone.0251025] [PMID] [PMCID]

[19] Sanderson DJ, Martin PE. Lower extremity kinematic and kinetic adaptations in unilateral below-knee amputees during walking. Gait Posture. 1997; 6(2):126-36 [DOI:10.1016/S0966-6362(97)01112-0]

[20] Nolan L, Wit A, Dudzin K, Lees A, Lake M, Wychowanski M. Adjustments in gait symmetry with walking speed in trans-femoral and trans-tibial amputees. Gait Posture. 2003; 17(2):142-51. [DOI:10.1016/S0966-6362(02)00066-8] [PMID]

[21] Genin JJ, Bastien GJ, Franck B, Detrembleur C, Willems PA. Effect of speed on the energy cost of walking in unilateral traumatic lower limb amputees. Eur J Appl Physiol. 2008; 103(6):655-63. [DOI:10.1007/s00421-008-0764-0] [PMID]

[22] Sibley AR, Strike S, Moudy SC, Tillin NA. The associations between asymmetries in quadriceps strength and gait in individuals with unilateral transtibial amputation. Gait Posture. 2021; 90:267-73. [DOI:10.1016/j.gaitpost.2021.08.027] [PMID]

[23] Mayank S, Haldane BE, Todd PR, Robert HJ, Bernard SF, Megan SJ. Time since lower-limb amputation. Am J Phys Med Rehabil. 2021. [DOI:10.1097/PHM.0000000000001736]

[24] De Asha AR, Buckley JG. The effects of walking speed on minimum toe clearance and on the temporal relationship between minimum clearance and peak swing-foot velocity in unilateral trans-tibial amputees. Prosthet Orthot Int. 2015; 39(2):120-5. [DOI:10.1177/0309364613515493] [PMID] [PMCID]

مقاله پژوهشی

تاثیر سرعت راه رفتن بر پارامترهای آن و مصرف انرژی در قطع عضو های یک طرفه ترانس تیبیال

سانگیتا پاترا[۱]، راجش کومار موهانتی[۱*]، ساکتی پراساد داس[۲]

۱. گروه ارتز و پروتز، موسسه آموزش و تحقیقات توانبخشی سوامی، کوتاک، اودشیا، هندوستان.
۲. گروه طب فیزیکی و توانبخشی، موسسه آموزش و تحقیقات توانبخشی سوامی، کوتاک، اودشیا، هندوستان.

تاریخ دریافت: ۳۰ شهریور ۱۴۰۰
تاریخ پذیرش: ۱۸ آبان ۱۴۰۰
تاریخ انتشار: ۰۹ دی ۱۴۰۰

چکیده

مقدمه آنالیز پارامترهای راه رفتن و مصرف انرژی در سرعت های مختلف راه رفتن در قطع عضوهای ترانس تیبال کمتر مورد تحقیق قرار گرفته است. بررسی این موارد می تواند پاسخدهی این افراد را مشخص کند. هدف اصلی مطالعه حاضر بررسی تاثیر تغییرات سرعت راه رفتن بر پارامترهای راه رفتن و مصرفی انرژی متابولیک در قطع عضوهای یک طرفه ترانس تیبال هنگام استفاده از پروتز است.

مواد و روش‌ها سیزده نفر دارای قطع عضو ترانس تیبیال با انجام تست ده متر راه رفتن با سرعت های متفاوت (راحت، سریع، آهسته) جهت بررسی پارامترهای راه رفتن مورد بررسی قرار گرفتند. پارامترهای راه رفتن تمپورال- اسپاشیال مانند طول قدم، طول گام، سرعت، کیدانس و شاخص ارزش فیزیولوژیک برای مصرف انرژی متابولیک در قالب ANOVA مورد تحلیل قرار می گیرد.

یافته‌ها طول قدم سمت پروتزی در سرعت راه رفتن سریع (۰/۶۷+۰/۱۰ m) از سرعت راحت طبیعی (۰/ ۵۶+۰/۱۳ m) بیشتر و از سرعت کم (۰/۴۲ + ۰/۰۶ m) کمتر بود. روال مشابه نیز در تمام پارامترهای راه رفتن مشاهده شد. کمترین میزان شاخص ارزش فیزیولوژیک برای سرعت راحت طبیعی (۰/۹۰+۰/۰۸) سپس سرعت راه رفتن سریع (۰/۰۸+۰/۱۱) و بالاترین میزان آن برای راه رفتن با سرعت آهسته (۰/۱۰ + ۰/۱۸) بود. تفاوت معناداری بین همه ی پارامترهای راه رفتن تمپورال-اسپاشیال و شاخص ارزش فیزیولوژیک در سه حالت سرعت وجود داشت. (P<۰/۰۵)

نتیجه گیری سرعت راه رفتن به طور مشخص در تمام پارامترهای انرژی و تمپورال- اسپاشیال آمپوته های یک طرفه ترانس تیبیال تحت تاثیر قرار می گیرد.

کلیدواژه‌ها:
پارامترهای راه رفتن، شاخص ارزش فیزیولوژیک، ترانس تیبیال، سرعت راه رفتن

Cite this article as Patra S, Mohanty RK, Prasad Das S. Effect of Walking Speed on Gait Parameters and Energy Expenditure in Individuals with Unilateral Trans-tibial Amputation. Function and Disability Journal. 2021; 4:E41. http://dx.doi.org/10.32598/fdj.4.41

doi http://dx.doi.org/10.32598/fdj.4.41

*** نویسنده مسئول:**
راجش کومار موهانتی
نشانی: گروه ارتز و پروتز، موسسه آموزش و تحقیقات توانبخشی سوامی، کوتاک، اودشیا، هندوستان
تلفن: ۸۹۶۰۹۹۳ (۷۰۰) ۹۱+
رایانامه: rajeshmpo48@gmail.com

This Page Intentionally Left Blank