THE ACCEPTABILITY OF TALARIA FOR ANKLE STRENGTHENING AMONG LICENSED PHYSICAL THERAPIST

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ABSTRACT

One of the crucial components in supporting body weight and maintaining balance during movement is the ankle joint. Injuries and neuromuscular diseases impair the muscles of the ankle, which further results in pain, instability, foot deformity, an abnormal gait, and disability. Ankle injuries are rehabilitated through physical therapy with the use of conventional and simple devices. However, it is evident that there are restrictions in time and availability of physical therapists, and it is labor intensive as well for patients. The aim of this study is to develop and determine the acceptability of TALARIA for ankle strengthening among licensed physical therapist. A descriptive research design has been used of which (21) licensed physical therapist were purposively selected to evaluate TALARIA using a modified standardized questionnaire in terms of individual features, functionality, materials, design, safety of use, and its overall acceptability. The degree of acceptability of TALARIA for ankle strengthening as to features, functionality, materials, design, and safety of the device were found to be acceptable among licensed physical therapists who met the required criteria as respondents of this study. Of all the parameters, materials got the highest weighted mean (4.30), while features came in second (4.27). Design ranked third (4.25), and safety ranked fourth (4.11). Functionality ranked last with a weighted mean of 3.69. The degree of overall acceptability for ankle strengthening among twenty-one licensed physical therapists were obtained with a weighted mean of 3.95 and interpreted as slightly acceptable on the scale used as an ankle rehabilitation device for strengthening. The TALARIA ankle exerciser is determined to be acceptable and recommended for physical therapy schools, rehabilitation clinics, and centers in strengthening the muscles of the ankle.

Keywords: Ankle strengthening, Acceptability, Ankle device, Rehabilitation

INTRODUCTION

One of the crucial components in supporting body weight and maintaining balance during movement is the ankle joint. Injuries and neuromuscular diseases impair the muscles of the ankle, which further results in pain, instability, foot deformity, an abnormal gait, and disability. (Racu C., & Doroftei I., 2014). Ankle injuries are rehabilitated through physical therapy with the use of conventional and simple devices. However, it is evident that there are restrictions in time and availability of physical therapists, and it is labor intensive as well for patients shown in multiple studies (Miao Q. et al., 2017; Huo Y. et al., 2021; Quanquan L. et

al., 2018; Dong M. et al., 2021; Yoo D. et al., 2018). As a result, the demand for rehabilitation devices emerges, and various academic institutions across the world are keen to design and create devices for ankle rehabilitation (Racu C., & Doroftei I., 2014; Alcocer W. et al., 2012). The aim of this study is to develop and determine the acceptability of TALARIA for ankle strengthening among licensed physical therapist.

LITERATURE REVIEW

Role of Ankle in Ambulation

The study of Brockett, C., & Chapman, G. (2016) discusses the ankle movement in gait cycle. It demonstrates a dorsiflexion moment at heel strike, as the dorsiflexors eccentrically contract to control the rotation of the foot and prevent the foot from slapping the ground. During the second phase, there is a plantar flexion moment as the ankle dorsiflexors contract eccentrically to allow forward progression of the shank over the foot. During the third phase, the plantar flexion moment continues with the plantar flexors contracting concentrically towards toe-off. As walking speed increases, ankle kinetic patterns stay similar but with larger magnitudes. It was supported by the study of Yoon, J.Y., An, D.H., & Oh, J.S. (2013), which adds that evertors and invertors provide balance and stability during terminal stance.
Ong C. F. et al. (2019) mentioned that the ankle plantarflexor muscles play an important role in human walking, and impairment in these muscles contributes to gait pathologies. This was supported in the studies of Vasquez-Galliano, J., Kimawi, I., & Chang, L. (2020), and Graham, H. (2007), which reported that weakness of plantar flexors and dorsiflexors during phases of gait cycle results in different gait deviations and may present compensatory recurvatum. Cho J. et al. (2021) explained how stroke affect normal gait due to ankle weakness and mentioned that weakness of plantar flexors reduces walking speed, and decreased dorsiflexion can lead to injurious falls.

Ankle Rehabilitation in Neuromuscular Diseases and Injuries

Kisner C., & Colby L. A. (2012) mentioned that ankle rehabilitation exercises aim to improve muscle performance, develop functional and dynamic neuromuscular control. Different studies address ankle impairments and gait pathologies with modalities and orthoses. In a study, Shin H.E. et al. (2022) investigated whether FES has various advantages for gait training in stroke patients. It can improve foot clearance during gait, functional balance, and walking ability, and showed similar results to ankle-foot orthoses. On the other hand, Lovegreen W., & Pai A. (2019) determined that the use of ankle-foot orthoses (AFOS) is used for ambulation, support, and assistance as it allows patients to do various gaits.

The studies of Alcocer W. et al. (2012), and Mattacola C., & Dwyer M. (2002) determined that ankle rehabilitation aims to return to same or higher level of function before the injury, without limitations. It is also reported in these studies that ankle rehabilitation is divided into three phases. The initial (acute) phase focuses on inflammation control; the rehabilitation phase (pain-free weight bearing) focuses on strength gain, isometric to isotonic exercises, and balance training; and finally, the functional (advance) phase returns to normal function such as running, jumping, and sports. However, Saglia J.A. et al. (2009) have summarized the rehabilitation protocol for ankle injuries. It is stated that in early stages of ankle therapy, passive exercises are mostly needed. Active exercises such as isometric and isotonic exercises are done next if the patient has achieved full range of motion, while the last stage focuses on proprioceptive training and balance exercises.

Limitations in Conventional Rehabilitation

There are numerous studies that proves limitations of conventional ankle rehabilitation. In the works of Miao, Q. et al. (2017) which determined that conventional rehabilitation programs for musculoskeletal and neurological disabilities require cooperative and intensive efforts from both therapists and patients. This emphasizes the importance of developing novel rehabilitation techniques to allow therapists to provide effective treatment interventions while reducing the burden on staff and resources. This was supported by the study of Huo, Y. et al. (2021), which reiterated that manual rehabilitation training relies on healthcare professionals, which is inefficient, labor intensive, and difficult to popularize and evaluate the rehabilitation effect objectively and accurately. The study of Quanquan L. et al. (2018) further defined that in traditional ankle exercises, physiotherapy (PT) manually holds patients' affected ankle to carry out different motions during ankle rehabilitation, which exhaust the physiotherapist. In addition, rehabilitation performance heavily relies on physiotherapy's experience.

In terms of stroke rehabilitation of the ankle, the studies of Dong, M. et al. (2021) and Yoo, D. et al. (2018) proved that traditional ankle rehabilitation requires a long, repetitive, and intensive process leading to a large workload as well as limitations, which include the cost and availability of physical therapists. This results in insufficient training frequency and intensity because of limited time and resources.

Emergence of Ankle Rehabilitation Devices

In the study of Racu, C., & Doroftei, I. (2014), which stated that as ankle impairments have a high incidence, the demand for an easy-to-manufacture rehabilitation device emerges. The use of mechanical ankle devices is suggested because it is easily programmed, financially affordable, and provide the two movements essential for complete ankle healing (dorsiflexion-plantarflexion and inversion-eversion). It is recommended that the main specifications for these devices should focus in safety, comfort, amount of force, size, and weight. These findings was supported by the work of Alcocer W. et al. (2012), which determined that in recent years, there has been tremendous interest in several research centers across the world to propose and develop automated systems for ankle rehabilitation. A very important feature is the inclusion of the function to strengthen the muscles and tendons of the ankle through active rehabilitation. These suggested ankle rehabilitation devices vary from one to six degrees of freedom.

In all the studies being found (Hussain, S., Jamwal, P., & Ghayesh, M., 2017; G. Liu, J. Gao et al., 2006; & Saglia, J. A. et al., 2010), it is reported that the development of different prototype ankle rehabilitation devices improves the workspace dexterity and can be done with just a little assistance from a physio therapist for the rehabilitation of patients that have ankle injuries or impairments. In addition, devices that showcase different types of ankle movements can increase the strength and healing time of the patient compared to manual therapy.

METHODOLOGY

Research Design

A descriptive research design was used in this study, and 21 licensed physical therapists were purposively selected to evaluate TALARIA for ankle strengthening using a modified standardized questionnaire in terms of individual features, functionality, materials, design, safety of use, and its overall acceptability. The descriptive method usually utilizes

questionnaire for data gathering. In order for the survey to be both valid and reliable, it is important that the questions written in the questionnaire are standardized. The gathered data then underwent statistical treatment and interpretation.

Participants, Inclusion, And Exclusion Criteria

21 Physical Therapist Registered in the Philippines (PTRP) who met the inclusion/exclusion criterion provided during the screening procedure were purposively selected. The inclusion criteria include the following: 1) Physical Therapist Registered in the Philippines (PTRP) 2). Either male or female 3). Those currently in clinical practice who provided with informed consent and were willing to participate in the study. On the other hand, the exclusion criteria are the following: 1) Outdated Professional Regulation Commission (PRC) license 2) Employed in rehabilitation centers and local health units in hospitals outside the first and second districts of Laguna (City of San Pedro, City of Cabuyao, and City of Santa Rosa) and the lone district of Biñan.

Instrumentation

The study made use of the TALARIA Exerciser (See Fig. 1) It is a device that assists in training of the ankle muscles in four different movements, namely, dorsiflexion, plantarflexion, inversion, and eversion. The advantage of TALARIA over standard rehabilitation device is that it is detachable, adjustable, portable, comfortable and safe. A free size shoe was customized to accommodates all sizes of foot and can be either be worn in left or right. TheraBand specifically an elastic tube, was used to provide various degree of resistance in the ankle movement depending on its color. One of its main features is portability, which was tested and approved by licensed physical therapists from various rehabilitation centers, including Perpetual Help Medical Center Bian, New Sinai MDI Hospital, Westlake Hospital Department of Physical Medicine and Rehabilitation, First Cabuyao Hospital and Medical Center, and Santa Rosa Community Rehabilitation Medicine.

TALARIA, which was above mentioned, has different parts (See Fig. 2). 1). A customized Velcro shoe is a free-size shoe that can be adjusted with the help of Velcro straps for different types of foot sizes, either left or right. The one that will hold and support the foot of the user during actions when using the device. 2). Flatform: A durable flat surface where the customized shoe will be placed on top, the one that will co-support the foot during the movement of the ankle, the one that will hold the TheraBand at the top part. 3). Ball and socket joints: mechanical bearing components that are fitted together, which allow pivoting and rotating motions; commonly used in construction equipment and automotives. This will allow for four (4) ankle movements. 4). TheraBand—latex bands specifically tubes, will serve as resistance against the desired ankle movement of the user; it can be detached to customize the amount of resistance needed for strengthening exercises of the ankle. 5). Base: The pair of crescent-like metals that will be attached at the bottom part of the shaft. This will serve as the support for the entire machine and the one that will hold the TheraBand at the bottom part. 6). Wing bolt: A special type of screw that has elongated wings that are designed to be operated by hand with ease. The one that will hold the shoe on the flatform, and the pair of crescent bases to the bottom shaft of the device. 7). Hooks: This will serve as the primary attachment of the TheraBand at the top and bottom parts of the device. A modified, standardized questionnaire has been formulated that consists of a series of questions with the purpose of gathering the information required from the respondents to prove the acceptability of the device. The formulated questionnaire (see Figure 3) for the study was based upon the

physical features, functionality, materials, design, and safety of the device, as well as how efficient and convenient it was. The patient's safety and comfort while using the device are of the utmost concern.

1a. Lateral View 1b. Isometric View 1c. Front View

Figure 1. TALARIA Exerciser Blueprint

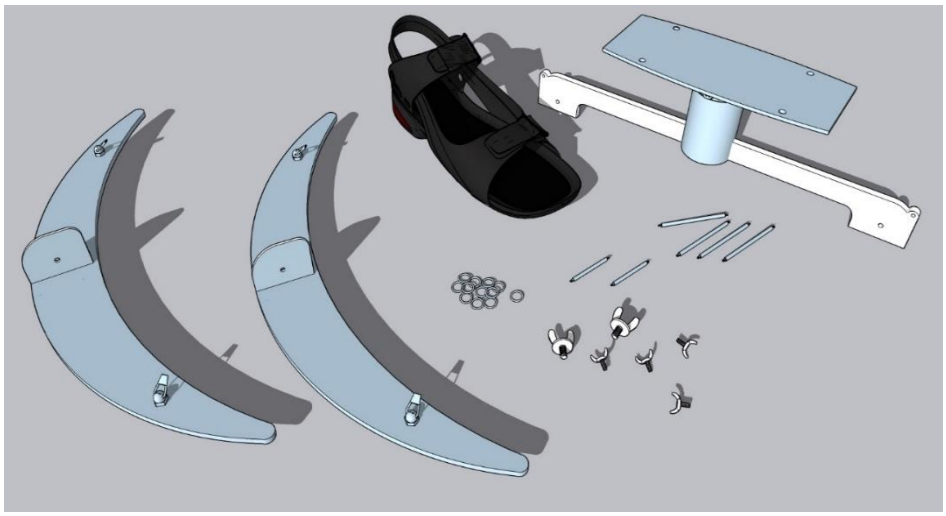

Figure 2. Disassembled Parts

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Name: _____

Instructions: Please encircle the most appropriate answer for each of the following items that will correspond most closely to your desired response.

5 Acceptable
4 Slightly Acceptable
3 Neutral
2 Slightly Unacceptable
1 Unacceptable

I. PRESENTATION OF THE DEVICE

A. Features

1. Resistance of each Thera band
   5 4 3 2 1
2. Rotation of the flat form
   5 4 3 2 1
3. Ease of comfort of the sandals attached to the flat form
   5 4 3 2 1
4. Portability
   5 4 3 2 1
5. Storage
   5 4 3 2 1

B. Functionality

1. Elasticity of the Thera band during plantar flexion, dorsiflexion, inversion ,eversion, lateral and medial rotation
   5 4 3 2 1
2. Resistance during plantar flexion and dorsiflexion
   5 4 3 2 1
3. Resistance during inversion and eversion
   5 4 3 2 1
4. Thera band slot for exercise progression
   5 4 3 2 1

C. Materials

1. Aluminum steel construction
   5 4 3 2 1
2. Materials of foot wear provides comfort while doing range of activities
   5 4 3 2 1
3. Cost effectiveness
   5 4 3 2 1
4. Durability
   5 4 3 2 1

D. Design

1. Aesthetic appearance
   5 4 3 2 1
2. Size of the device
   5 4 3 2 1
3. Weight of the device
   5 4 3 2 1
4. Range of activities users are able to carry out
   5 4 3 2 1

E. Safety

1. The adjustable clamp where Theraband is attached is secured
   5 4 3 2 1
2. Parts of the device are not slippery
   5 4 3 2 1
3. TALARIA functionality safety
   5 4 3 2 1
4. Secured lock system of the attachment of the footwear to the flat form
   5 4 3 2 1

II. RATING OF THE DEVICE

Is TALARIA acceptable as a device for ankle strengthening?
5 4 3 2 1

Remarks:

_____
_____
_____
_____
_____
_____

Figure 3. Sample of Modified Standardized Questionnaire

Data Gathering Procedure

This study was conducted into three phases. In pre-implementation phase, the researchers presented a letter of permission to the dean of college of physical therapy to allow the implementation of the study. Letter of consent was given to the participants who passed the criteria set forth by the researchers. All the individuals who met the criteria were oriented before implementation, which included providing sufficient information and explaining their rights as participants. During the implementation phase, the researchers visited the rehabilitation centers of Perpetual Help Medical Center Biñan, New Sinai MDI Hospital, Westlake Hospital Department of Physical Medicine and Rehabilitation, First Cabuyao Hospital, Medical Center, and Santa Rosa Community Rehabilitation Medicine. Eligible participants tested and evaluated the TALARIA and were given questionnaires to determine its acceptability as an ankle strengthening device. In the post-implementation phase, all relevant data have been collected and plotted in a table. A Likert scale of acceptability (see table 1) was used to interpret and measure the extent of acceptability of TALARIA in terms of its design, materials, functionality, features, and safety, as well as the overall acceptability of TALARIA as an ankle strengthening device among licensed physical therapists.

SCORE	RANGE	INTERPRENATION
5	4.21 – 5.00	Acceptable
4	3.41 – 4.20	Slightly Acceptable
3	2.61 – 3.40	Neutral
2	1.81 – 2.60	Slightly Unacceptable
1	1.00 – 1.80	Unacceptable

Table 1: Likert Scale of Acceptability

Statistical Treatment of Data

To perform the statistical treatment needed, following statistical tools were used. Weighted mean, to determined the extent of acceptability of TALARIA in terms of its design, materials, functionality, features, and safety, as well as the overall acceptability of TALARIA as an ankle strengthening device among licensed physical therapists. Frequency and percentage distribution, to describe the profile of the registered physical therapist.

RESULTS

The degree of acceptability of TALARIA for ankle strengthening among twenty-one licensed physical therapists All bounds as to features, functionality, materials, design, and safety of the device were found to be acceptable among licensed physical therapists who met the required criteria as respondents to the study. Of all the parameters, materials got the highest weighted mean with 4.30, and features came in second with a weighted mean of 4.27. Design ranked third with a weighted mean of 4.25. The safety ranked fourth with a weighted mean score of 4.11. Functionality ranked last with a weighted mean of 3.69. The degree of overall acceptability for ankle strengthening among twenty-one licensed physical therapists obtained a weighted mean of 3.95 and was interpreted as slightly acceptable on the scale used, as an ankle rehabilitation device for strengthening.

Table 2a. The Acceptability of TALARIA for Ankle Strengthening Among Licensed Physical Therapist as to Features

Feature Parameters	Weighted Mean	Interpretation	Rank
Resistance of each Thera band	3.81	Slightly Acceptable	5
Rotation of the flat form	4.10	Slightly Acceptable	4
Ease of comfort of the sandals attached to the flat form	4.67	Acceptable	1
Portability	4.29	Acceptable	3
Storage	4.48	Acceptable	2
Average Weighted Mean	4.27	Acceptable	

Table 2b. The Acceptability of TALARIA for Ankle Strengthening Among Licensed Physical Therapist as to Functionality

Functionality Parameters	**Weighted Mean**	**Interpretation**	**Rank**
Elasticity of the Thera band during the movement	3.67	Slightly Acceptable	3
Resistance during plantar flexion and dorsiflexion	3.76	Slightly Acceptable	2
Resistance during inversion and eversion	3.52	Slightly Acceptable	4
Thera band slot for exercise progression	3.81	Slightly Acceptable	1
Average Weighted Mean	3.69	Slightly Acceptable	

Table 2c. The Acceptability of TALARIA for Ankle Strengthening Among Licensed Physical Therapist as to Materials Used for Construction

Materials Parameters	Weighted Mean	Interpretation	Rank
Aluminum Steel Construction	4.52	Acceptable	2
Materials of footwear provides comfort while doing range of motion activities	4.62	Acceptable	1
Cost-effectiveness	3.86	Slightly Acceptable	4
Durability	4.19	Slightly Acceptable	3
Average Weighted Mean	4.30	Acceptable	

Table 2d. The Acceptability of TALARIA for Ankle Strengthening Among Licensed Physical Therapist as to Design

Design Parameters	Weighted Mean	Interpretation	Rank
Aesthetic Appearance	4.43	Acceptable	2
Size of the device	4.48	Acceptable	1
Weight of the device	4.05	Slightly Acceptable	3
Range of activities users are able to carry out	4.05	Slightly Acceptable	3
Average Weighted Mean	4.25	Acceptable	

Table 2e. Table 1e. The Acceptability of TALARIA for Ankle Strengthening Among Licensed Physical Therapist as to Safety

Safety Parameters	Weighted Mean	Interpretation	Rank
The adjustable clamp where Thera band is attached is secured	4.10	Slightly Acceptable	2
Parts of the device are not slippery	4.10	Slightly Acceptable	2
TALARIA functionality safety	4.10	Slightly Acceptable	2
Secured lock system of the attachment of the footwear to the flat form	4.14	Slightly Acceptable	1
Average Weighted Mean	4.11	Slightly Acceptable	

Table 3a. The Acceptability of TALARIA For Ankle Strengthening Among Licensed Physical Therapist as to Overall Rating

	Weighted Mean	Interpretation
Overall Rating	3.95	Slightly Acceptable

DISCUSSION

In this study, which aimed to develop and determine the acceptability of TALARIA for ankle strengthening, it was hypothesized that it is not an acceptable device among licensed physical therapist. Two (2) research questions must be addressed to answer this hypothesis. The first question focused on determining the extent of acceptability of TALARIA in terms of features, functionality, materials, design, and safety. Here, it was found that all parameters were acceptable. Of all parameters, materials got the highest weighted mean of 4.30, and features came in second with a weighted mean of 4.27. Design ranked third with a weighted mean of 4.25. Safety ranked fourth with a weighted mean score of 4.11. Functionality ranked last with a weighted mean of 3.69. On the other hand, the second question focused on determining the extent of overall acceptability of TALARIA for ankle strengthening among licensed physical therapist. The degree of overall acceptability obtained a weighted mean of 3.95 among twenty-one licensed physical therapist and was interpreted as slightly acceptable

as an ankle rehabilitation device for strengthening. The results of the data on the device parameters are in line with the study of Racu, C., and Doroftei, I. (2014), which stated that the recommended specifications of ankle devices should concern with safety, comfort, precision of force, size, and weight. The choice of the right materials is compatible with developing an innovative ankle rehabilitation device, it performs well in its functionality. The design of TALARIA is aesthetically pleasing, which may give a quality impression to the patient, as well as the carefully thought-out movement of the device. Some parameters need improvement, such as adjusting the length of the TheraBand and having different resistance based on color coding, which will improve the resistance and ease-identification of the elastic bands. Modifying TALARIA's base with the use of rubber will improve the hold to adapt to different types of surfaces to avoid sudden slippage of the device, creating a more susceptible device that is acceptable for rehabilitation use, specifically for ankle strengthening. Patient safety is the utmost concern when using the device.

Even though the result of this study seems acceptable, researchers have found limitations during implementation and with the recommendations of the participants. Modification of TheraBands in various lengths and its resistance should be measurable to allow objective findings. The height of the device should also be adjustable to accommodate different heights of individuals. The knee should be stabilized to avoid substitute movements. Enhance the ball and socket mechanism to allow full ROM of inversion and eversion, and use rubber on the base of the device to avoid slipping. It was therefore recommended that future studies conduct similar studies with a larger sample size.

CONCLUSIONS

The statistical data have shown that the weighted mean of TALARIA's parameters is determined to be acceptable in terms of features, materials, and functionality. On the other hand, it is slightly acceptable in terms of functionality, safety, and overall acceptability after it was tested and evaluated by licensed physical therapists in different rehabilitation centers. Therefore, the researchers conclude that the TALARIA ankle exerciser is acceptable and recommended for physical therapy schools, rehabilitation clinics, and centers in strengthening the muscles of the ankle.

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