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Research

The Effect of Ankle Foot Orthosis Use on the Running Speed in Post Stroke Patients: A Meta Analysis

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ABSTRACT

Background: Stroke is a disease that occurs because blood flow to certain locations in the brain is disrupted. One of the main problems that occur in stroke sufferers is the disruption in the ability to walk, which will cause a decrease in the walking speed of post-stroke patients. One of the treatments used to increase the walking speed of post-stroke patients is to provide an ankle foot orthosis. The purpose of this study was to estimate the magnitude of the effect of using ankle foot orthosis on increasing walking speed of post-stroke patients by conducting a meta-analysis in the same articles.
Subjects and Method: The meta-analysis was carried out by systematically reviewing the same number of articles from PubMed, Science Direct, Google Scholar, using the search keywords "ankle foot orthosis" OR "AFO" AND "Stroke" OR "patient stroke" AND "walking speed" OR "Velocity" AND "randomized control trial". The inclusion criteria used were full paper articles with a randomized controlled trial (RCT), the intervention given was the use of an ankle foot orthosis with a comparison without using an ankle foot orthosis. The research subjects were post-stroke patients of all ages. The study outcome was walking speed, and the article is one in a worldwide study whose research reports an effect size (with mean and standard deviations). Meta-analyzes were performed using RevMan 5 with fixed effect models.
Results: Meta-analysis of 6 randomized controlled trial articles from the Netherlands, Turkey, India, United Kingdom, Paris, and Canada concluded that the use of 0.09 ankle foot orthosis was higher in increasing the walking speed of post-stroke patients than not using ankle foot orthosis (ES= 0.09; 95% CI= 0.16 to 0.35; p= 0.470). Heterogeneity I^2= 19%.
Conclusion: The use of ankle foot orthosis has an effect on increasing walking speed in post-stroke patients, but it is not statistically significant.

Keywords: stroke, ankle foot orthosis, walking speed

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BACKGROUND

Stroke occurs when blood flow to a certain location in the brain is impaired. Locations in oxygen-deprived areas become damaged and cause certain symptoms. The type and severity of neurologic deficits have symptoms that vary depending on which part of the brain is affected (Tarwoto, 2013). According to Riskesdas in 2018, the prevalence of stroke in Indonesia has increased with age.

The highest stroke cases diagnosed occurred at the age of 75 years and over (50.2%) and the lowest occurred in the 15-24 year age group, namely 0.6%. The prevalence of stroke based on gender was more male (11.0%) than female (10.9%). Based on place of residence, the prevalence of stroke in urban areas was higher (12.6%) compared to rural areas (8.8%).

Stroke causes reduced mobility by as much as 50% of the stroke population due to hemiparesis. One of the main problems that occur in stroke patients is the impaired ability to walk, although 70% of stroke sufferers regain the ability to walk, they experience functional problems caused by spasticity, muscle weakness and poor balance. Drop foot causes abnormalities when swinging and reduced stability during the stance phase, resulting in decreased walking speed and an increased risk of falling (Shababi et al., 2019).

Prosthetic Orthotics is a health service provided by Prosthetic Orthotics in terms of medical aids in the form of orthoses or prostheses for physical and psychological health based on science and technology to improve the health status of individuals, groups and communities due to impaired function and movement of limbs and trunk. (torso) and loss of limbs which can cause anatomical, physiological, psychological and sociological disorders / abnormalities (Permenkes No. 22/2013).

Ankle foot orthosis (AFO) is an orthopedic tool in the form of a splint so that it can partially cover the area of the lesion or disability that will be attached to the ankle area. Ankle foot orthosis has the main function as an orthopedic aid that is able to fix the ankle joint to maintain the position of the foot in the normal human anatomical shape.

SUBJECTS AND METHOD

1. Study Design

This was a systematic study and meta-analysis. The articles used in this study were obtained from PubMed, Science Direct, and Google Scholar databases. The keywords for finding articles are as follows: "ankle foot orthosis" OR "AFO" AND "Stroke" OR "patient stroke" AND "walking speed" OR "velocity" AND "randomized controlled trial".

2. Inclusion Criteria

The articles included in this study are full text articles with a randomized controlled trial study design. The research subjects were post-stroke patients of all ages. Selected article discussed the use of ankle foot orthosis with the outcome of increasing walking speed.

3. Exclusion Criteria

The articles published in this study are published articles other than using Indonesian and English.

4. Operational Definition of Variables

Walking speed is the distance covered by the entire body in a certain time, measured in meters/ second. Instrument: Stopwatch with continuous measuring scale.

Ankle foot orthosis is a tool that is used outside the body with a function to correct defects in the ankle and foot. Instrument: Medical records with categorical measuring scale.

5. Data Analysis

Data processing was carried out by the Review Manager (RevMan 5.3) by calculating the standardized mean difference to determine the research model that was combined and formed the final meta-analysis result.

RESULTS

The process of searching for articles by conducting database searches with PRISMA flow diagrams can be seen in Figure 1.

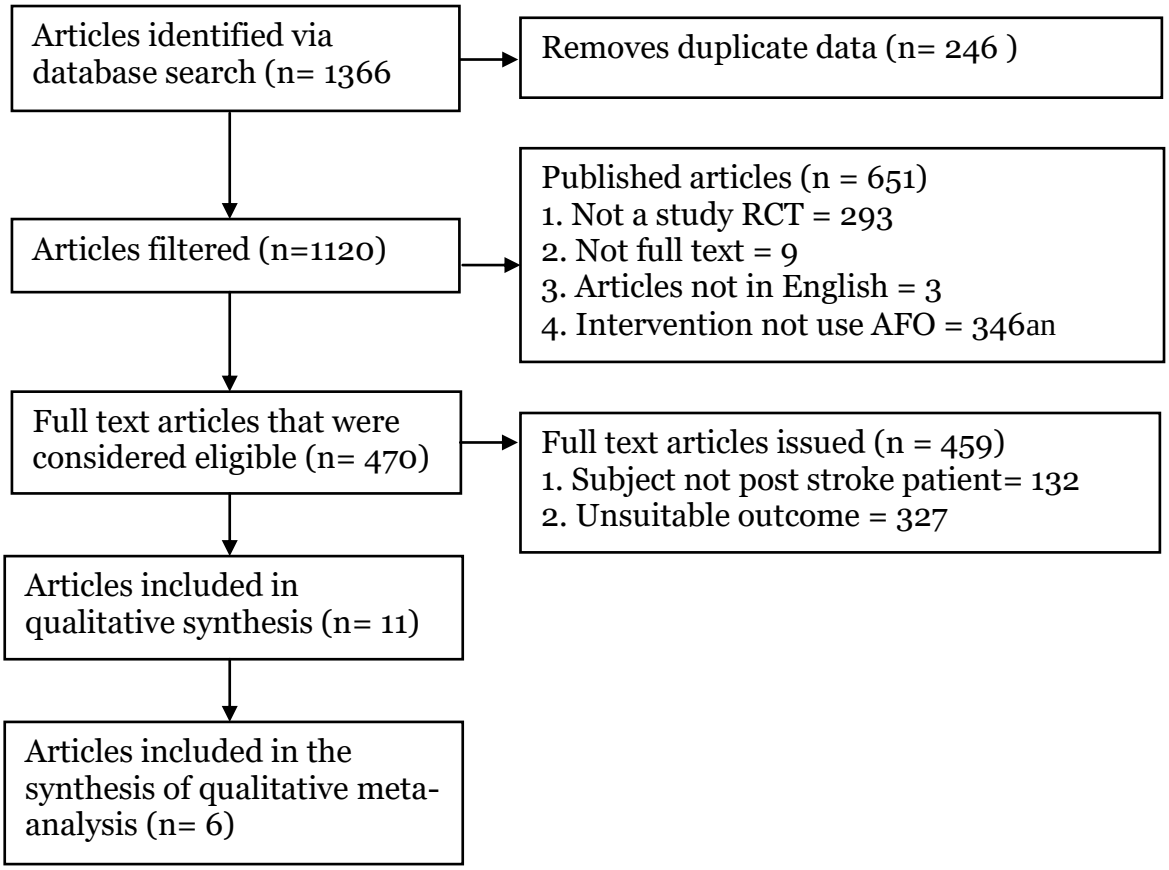

Figure 1. PRISMA flow diagram

a. Forest plot

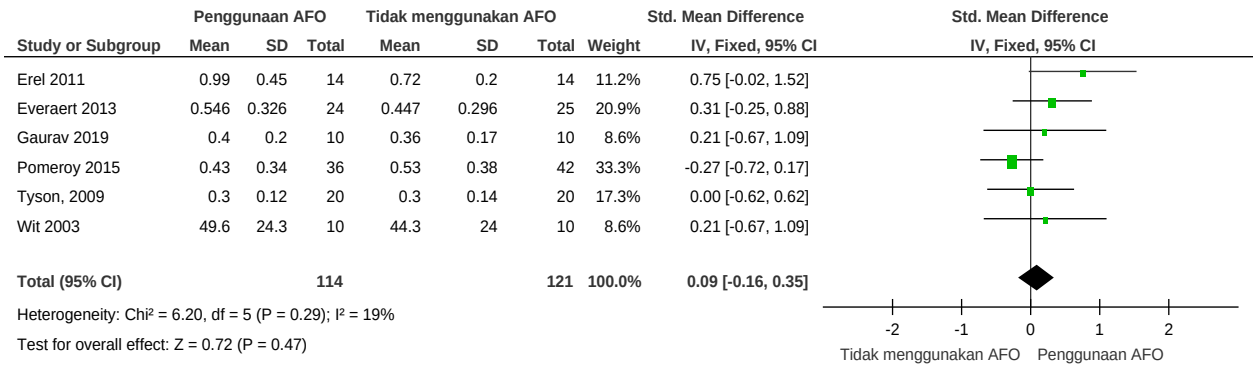

Figure 2. Forest plot of the effect of using the ankle foot orthosis against an increase in walking speed

b. Funnel plot

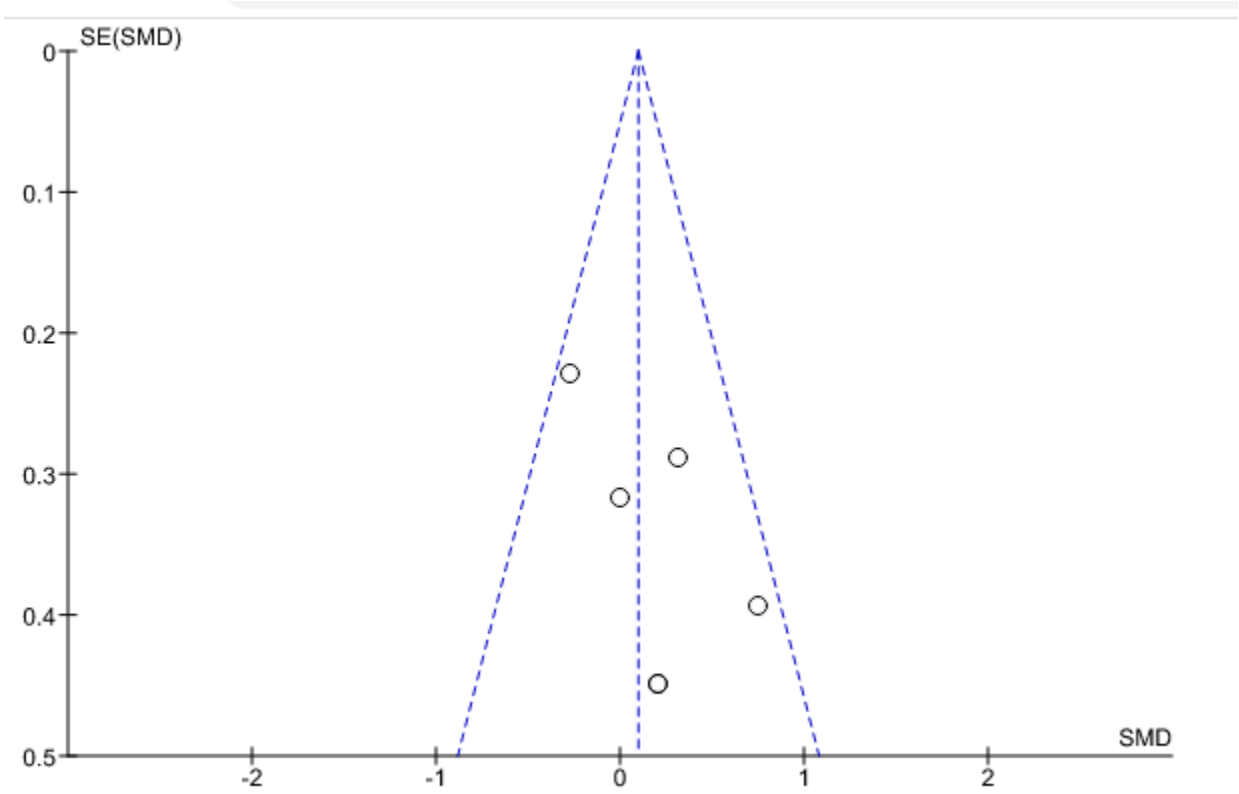

Figure 3. The effect of using the ankle foot orthosis against an increase in walking speed

The results of the forest plot (Figure 2) show that the use of an ankle foot orthosis 0.09 increased walking speed in post-stroke patients when compared without using an ankle foot orthosis and was not statistically significant (p = 0.470). The heterogeneity of the research data shows I^2= 19% so that the distribution of the data is declared homogeneous (fixed effect model).

The funnel plot (Figure 3) shows a publication bias characterized by asymmetry of the right and left plots where 2 plots are on the left and 3 plots are on the right. The plot on the left of the graph has a standard error between 0.2 and 0.3 and the plot on the right has a standard error between 0.2 and 0.5.

Table 1 Assessment of Study Quality

Checklists Questions	Wit et al., (2003)			Erel et al. (2011).			Gaurav et al., (2019)			Tyson et al., (2009)			Pomeroy et al., (2015)			Everaert et al., (2013)		
	Yes	Not explained	No	Yes	Not explained	No	Yes	Not explained	No	Yes	Not explained	No	Yes	Not explained	No	Yes	Not explained	No
Does this research address a clear research focus?	√			√			√			√			√			√		
Is the Randomized Controlled Trial research method suitable for answering research questions?	√			√			√			√			√			√		
Are there enough subjects in the study to establish that the findings were not made by chance?	√			√			√			√			√			√		
Were subjects randomly allocated to the experimental and control groups? If not, could this be biased?	√			√			√			√			√			√		
Are inclusion / exclusion criteria used?	√			√			√			√			√			√		
Were the two groups comparable at study entry?	√			√			√			√			√			√		
Are objective and unbiased outcome criteria?	√			√			√			√			√			√		
Are objective and validated measurement methods used to measure the results? If not, were the results scored by someone who did not know the group assignment (i.e. was the grading blended)?	√			√			√			√			√			√		

Checklists Questions	Wit et al., (2003)			Erel et al. (2011).			Gaurav et al., (2019)			Tyson et al., (2009)			Pomeroy et al., (2015)			Everaert et al., (2013)		
	Yes	Not explained	No	Yes	Not explained	No	Yes	Not explained	No	Yes	Not explained	No	Yes	Not explained	No	Yes	Not explained	No
Is the effect size practically relevant?	√			√			√			√			√			√		
How precise is the estimated effect? Is there a confidence interval?	√			√			√			√			√			√		
Could there be confounding factors that have not been taken into account?	√			√			√			√			√			√		
Are the results applicable to your research?	√			√			√			√			√			√		

✓ If the answer is Yes

Table 2

c. The use of ankle foot orthosis to increase walking speed

6 The article proves that there is an effect of using ankle foot orthosis on increasing walking speed in post-stroke patients

Author (Year)	Country	Study Design	Sample	P	I	C	O
Wit et al., (2012).	Netherlands	Randomized Controlled Trial.	Using AFO: 10 Not using AFO: 10	Post stroke patients aged 40-75 years	Seeing the effect of using ankle foot orthosis on walking speed *, balance and fear of falling in post-stroke patients	Did not see the effect of using ankle foot orthosis on walking speed, balance and fear of falling in post-stroke patients	Increased running speed
Erel et al. (2011).	Turkey	Randomized Controlled Trial.	Using AFO: 14 Not using AFO: 14	Post stroke patients who have recovered more than 6 months who are older than 18 years.	Seeing the effect of using ankle foot orthosis on Functional Reach, Timed Up and Go, Timed Up Stairs, Timed Down Stairs, gait velocity * and Physiological Cost Index in post-stroke patients	Did not see the effect of using ankle foot orthosis on Functional Reach, Timed Up and Go, Timed Up Stairs, Timed Down Stairs, Gait velocity and Psychological Cost Index in post-stroke patients	Increased running speed

Author (Year)	Country	Study Design	Sample	P	I	C	O
Gaurav et al., (2019).	India	Randomized Controlled Trial.	Using AFO: 10 Not using AFO: 10	Patients with a history of cerebrovascular accidents	Look at the effect of using the ankle foot orthosis on a 10 meter walking test *, a 6 minute walk test, physiological cost index, stride length, stride length, stand-swing ratio, single leg support, time and time test, ankle kinematics, feedback for grade satisfaction.	Did not see the effect of using ankle foot orthosis on the 10 meter walking test, 6 minute walk test, physiological cost index, stride length, stride length, stand-swing ratio, single leg support, time and time test, ankle kinematics, feedback for grade satisfaction.	Increased running speed
Tyson et al., (2009).	United Kingdom	Randomized Controlled Trial.	Using AFO: 20 Not using AFO: 20	Post stroke patients who are able to walk 5 meters without physical support	Seeing the effect of using ankle foot orthosis on functional mobility of walking disorders (speed *, weak footstep length), and patient opinion.	Does not see the effect of the use of ankle foot orthosis on functional mobility impaired walking (speed, low stride length), and the opinion of the patient.	Increased running speed
Pomeroy et al., (2015).	Paris	Randomized Controlled Trial.	Using AFO: 36 Not using AFO: 42	Post stroke patients who are older than 18 years	Looking at the effect of using the ankle foot orthosis on walking speed *, FAC, Modified Rivermead Mobility Index (MRMI), peak angular velocity of the knee, gait symmetry, and tibia angle to the ground when walking.	Did not see the effect of using ankle foot orthosis on walking speed, FAC, Modified Rivermead Mobility Index (MRMI), peak angular velocity of the knee, gait symmetry, and tibia angle of the ground while walking.	Increased running speed
Everaert et al., (2013).	Canada	Randomized Controlled Trial.	Using AFO: 24 Not using AFO: 25	Post-stroke patients who have recovered less than a year	To examine the effect of using ankle foot orthosis on walking speed * of post-stroke patients	Did not see the effect of using ankle foot orthosis on walking speed of post-stroke patients	Increased running speed

DISCUSSION

Stroke has a share in causing disability number one in the world and ranks the highest cause of death after heart disease and cancer.

Systematic review and meta-analysis in this study were carried out with the aim of increasing the generalizability of the findings and obtaining convincing conclusions from the various results of similar studies regarding the effect of using ankle foot orthosis on walking speed in post-stroke patients. I^2= 19%.

A study by Erel et al. (2011) states that the use of ankle foot orthosis for post-stroke patients with foot motor deficits is beneficial in increasing walking speed. This is because the use of ankle foot orthosis can improve the ability of the foot to lift the foot during the swing phase and increase stability during the tread phase, thereby increasing the ability to walk in post-stroke patients.

AUTHOR CONTRIBUTION

Muhibbah fatati is the main researcher who selects topics, searches and collects research data. Setyo Sri Rahardjo and Hanung Prasetya played a role in analyzing data and reviewing research documents.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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