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Efficacy of PNF Training Vs Agility Training on Mobility & Balance in Unilateral Trans Tibial Amputee

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ABSTRACT

Introduction: According to W.H.O, there are more than one million amputations performed every year, with up to 70% of these amputations related to diabetes. There were an estimated 1.6 million individuals living with the loss of a limb in 2006, these estimation are expected to more than double to 3.6 million such individuals by the year 2050.

Objective: To find out the effect of two different types of training procedure on mobility and balance in unilateral transtibial amputees using prosthesis during walking.

Hypothesis:

- To measure the effect of Pnf training on mobility and balance in unilateral transtibial amputees using prosthesis during walking.
- To measure the effect of Agility training on mobility and balance in unilateral transtibial amputees using prosthesis during walking.

Design: Pretest-Post-test experimental study.

Participants: Total (30) 15 numbers of subjects were taken each in the Group A (Proprioceptive Neuromuscular Facilitation group), Group B (Agility group).

Main outcome measures:

- Berg balance scale:
- Amputee mobility predictor:

Results: The group A (PNF training) showed significant results (p value=.04), and the group B(Agility training) showed significant results (p value=.02). The Group B (Agility training) showed more significant results as the P value was lesser than that of Group A (PNF training).Thus Agility training treatment method is more effective than the PNF training treatment method.

Conclusions: On the basis of the finding of the study, it can be concluded that both the Proprioceptive neuromuscular facilitation and Agility training both are effective in improving mobility and balance in unilateral transtibial amputee patient. But, conventional therapy along with Agility training yields more significant improvement in balance and mobility; than the Proprioceptive neuromuscular facilitation along with conventional occupational therapy.

KEYWORDS: *Amputation, Transtibial, Proprioceptive neuromuscular facilitation (PNF), Agility training, balance, static standing, weight bearing, postural control*

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INTRODUCTION

An amputation is defined as "the removal of a limb or other appendage or outgrowth of the body" (Dorland and Anderson 2003).[1]

Amputation can be divided up into two clearly identifiable groups: the first group consists of healthy, often younger individuals who happen to have fallen victim to amputation following a traumatic accident. These persons usually have a long term survival rate as well as successful recuperation. The second group are often older with various chronic illnesses such as diabetes and peripheral vascular disease, which complicate their long-term medical prognosis considerably (Houghton, Taylor, Thurlows, Rootes& McColl, 1992).[3]

According to W.H.O, there are more than one million amputations performed every year, with up to 70% of these amputations related to diabetes. In Britain estimated population was 60,270,708 and prevalence rate was 421,894.In the United States, 30,000-40,000 amputations are performed annually. There were an estimated 1.6 million individuals living with the loss of a limb in 2006, these

estimation are expected to more than double to 3.6 million such individuals by the year 2050.

Transtibial amputation is responsible for bio mechanical changes and for modifications in both afferent and efferent projection. Because of this impairment, equilibrium is difficult to control for Transtibial amputees.[8]Walking with a prosthetic limb is the primary goal of rehabilitation after a lower limb amputation. With a well-planned physical therapy program, amputees can walk in a pattern that approximates the normal gait.[7]

The desire of amputees to perform more vigorous indoor and outdoor activities and sports has posed more challenges to rehabilitation practitioners in their quest to maximize the functional capacity of their clients. Strength, balance, and gait training have become an integral part of the rehabilitation protocol, which can be achieved through agility training or through Proprioceptive neuromuscular facilitation techniques.[12]

Proprioceptive neuromuscular facilitation (PNF) is an integrated approach that treats an individual as a whole person, rather than merely focusing on a body segment.[13]Gailey and Clark et al., suggested that the neuromuscular facilitation system may effectively achieve static standing, weight bearing steadiness and dynamic walking, and weight shifting stability for amputees.[13]

Agility can be simply defined as an ability to quickly stop and restart motion, there is a high degree of complexity to this motor skill. First, developing agility will provide a strong foundation for neuromuscular control and motor skill function, thereby establishing overall athleticism. Second, changing directions is a common cause of injury, so by teaching individuals proper movement mechanics we may be able to reduce injury risk. Finally, a heightened ability to quickly change directions will enhance overall performance in both proactive offensive and reactive defensive circumstances.[15]

Agility training helps in strengthening and conditioning program of the lower limb and focuses on increasing the balance confidence of the lower limb amputee.[14]Agility is commonly defined as an effective and quick coupling of braking, changing directions and accelerating again while maintaining motor control in either a vertical or horizontal direction.[15]

Essential components of smooth and energy-efficient walking are good balancing abilities and postural control. A Canadian study (Miller et al, 2001) examined prevalence and risk factors of falling and fear of falling among lower limb amputees. They included in the study 435 people with lower limb amputation (75% transtibial amputations, 25% transfemoral amputations). The results have shown that approximately 50% of subjects experienced falling and the same percentage of subjects reported fear of falling. Conversely, mastering balance abilities improves the amputee's prosthetic skills and provides confidence for gait and more complicated tasks.

These studies are showing that proprioceptive neuromuscular facilitation training and agility training both are very much effective in improving the mobility and balance in unilateral transtibial amputee.[16]

Very few studies have been conducted, where a comparison has been done between the PNF training and the AGILITY training therefore the purpose of this study is to find out the effect of PNF training Versus Agility training on balance and mobility in unilateral transtibial amputee.

AIM AND OBJECTIVES

AIM:

To find out the effect of two different types of training procedure on mobility and balance in unilateral transtibial amputees using prosthesis during walking.

OBJECTIVES:

- To measure the effect of Pnf training on mobility and balance in unilateral transtibial amputees using prosthesis during walking.
- To measure the effect of Agility training on mobility and balance in unilateral transtibial amputees using prosthesis during walking.

EXPERIMENTAL HYPOTHESIS:

There will be significant difference on mobility and balance in the Pnf training versus Agility training in unilateral transtibial amputee.

NULL HYPOTHESIS

There will be no significant difference on mobility and balance in the Pnf training versus Agility training in unilateral transtibial amputees.

MATERIAL AND METHODS

STUDY AREA:

Department of Occupational Therapy, NILD, Kolkata

STUDY SAMPLE:

Subjects referred from OPD with a diagnosis of unilateral transtibial amputee were taken for the study.

STUDY PERIOD:

Study duration was 4 weeks.

SAMPLE SIZE:

Total 15 numbers of subjects were taken each in the Group A(Proprioceptive Neuromuscular Facilitation group) Group B(Agility group).

SAMPLE DESIGN:A sample of convenience for the Group A& B recruited from the Department of Occupational Therapy services at NILD,OPD

STUDY DESIGN:

This is a Pretest-Post-test experimental study consisting of the comparison of balance and mobility in patients with unilateral transtibial amputee.

INCLUSION CRITERIA:

1. Both male and female.
2. Age between 21 to 50 years.
3. Only unilateral transtibial amputee using patella tendon bearing socket.
4. Cause of amputation – traumatic.

5. Full ROM of Hip joint, knee joint and strength ≥ 4 in MMT.
6. Good upper extremity strength.
7. Able to understand the command.
8. Immediately after discharge and fitment of prosthesis.

EXCLUSION CRITERIA:

1. Other associated Neurological or Orthopedics condition.
2. Complicated stump (pain, wound, etc.)
3. Subjects having associated psychiatric condition.
4. Subjects with sensory motor impairment due to a neurological condition.
5. Subjects with perceptual disorder.

OUTCOME MEASURES

1. BERG BALANCE SCALE:
2. AMPUTEE MOBILITY PREDICTOR:

PROCEDURE

Informed consents were obtained from all participants. Baseline assessment were performed on Berg Balance Scale(BBS) and Amputee mobility Predictor(AMP) Screening of participants were done on the basis of inclusion criteria including scoring of Berg Balance Scale(BBS) and Amputee mobility Predictor(AMP).Others were excluded on the basis of medical reports. Now patients were randomly divided into two groups, Group A (PNF training) and Group B (Agility training). Patients in Group A were given Proprioceptive neuromuscular facilitation along with Conventional Occupational Therapy and patients in Group B were given agility training along with Conventional Occupational Therapy. Subjects of both the groups were treated three days a week for a total period of 4 weeks. Each session was of 40 minutes. Follow up assessments were done at the end of 4th week on outcome measures.

INTERVENTION

INTERVENTION FOR THE GROUP A

PNF+ Conventional Occupational Therapy.

Duration of Therapy 40 minutes sessions (30 minutes for PNF +10 minute'sconventional occupational therapy) three days in a week for 4 weeks.

The participants of Group A practiced PNF exercises.

PNF TRAINING

Fig. 1: Approximation

Fig. 2Slow reversal training in unilateral transtibial amputee

INTERVENTION FOR THE GROUP B

Agility training + Conventional Occupational Therapy

Duration of Therapy 40 minutes sessions (30 minutes for Agility training +10minutes conventional occupational therapy) three days in a week for 4 weeks.

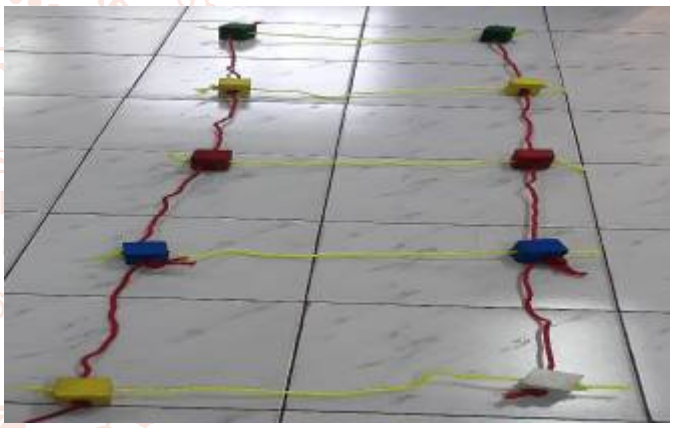
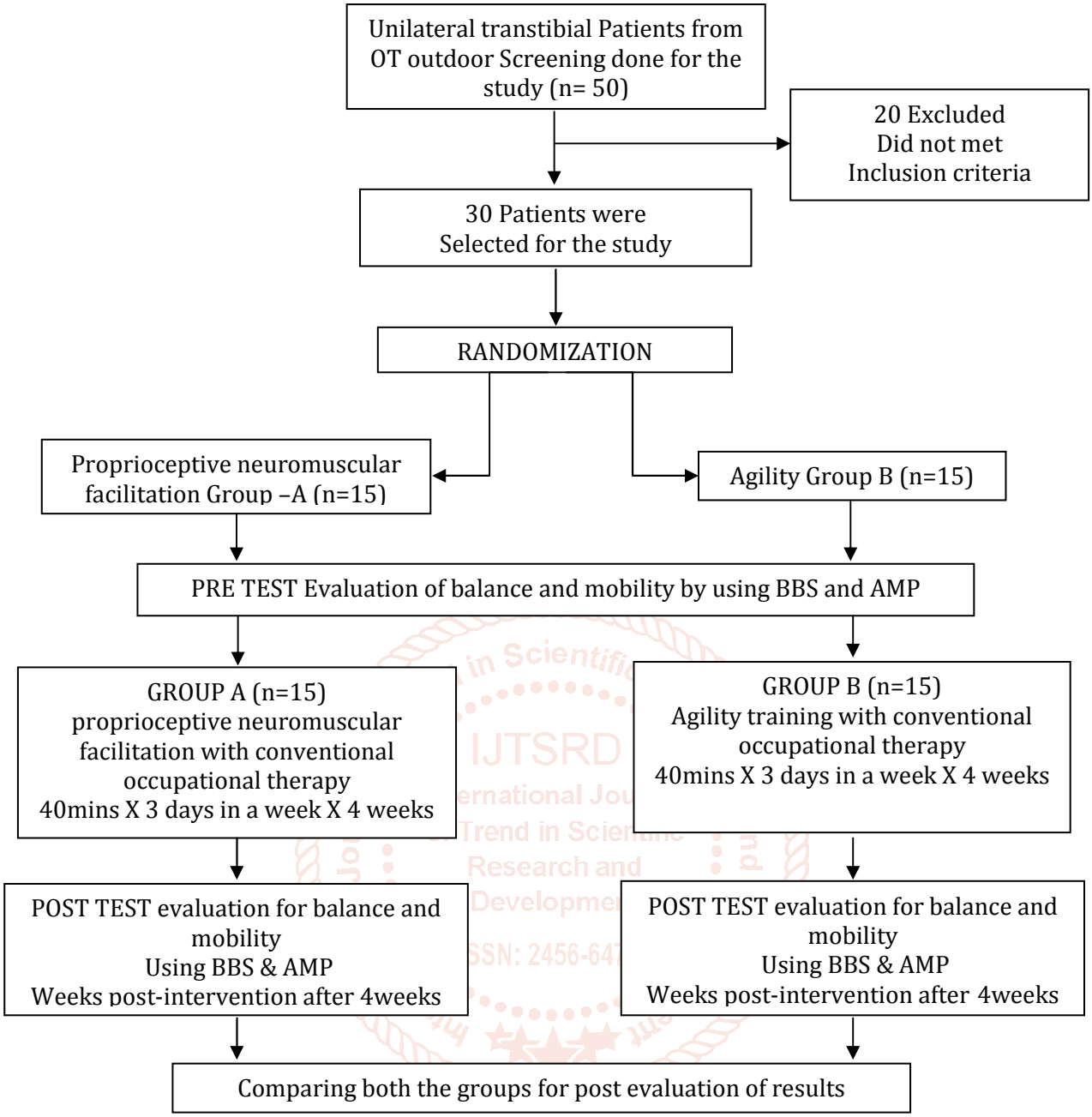


Fig. 3Agility ladder

Fig. 4Agility ladder training in unilateral transtibial Amputee

FLOWCHART



DATA ANALYSIS

The confidence interval set at p = 0.5.The Confidence Interval was kept at the standard level of 95% and the data was analyzed using IBM SPSS Version 23 (SPSS, Inc, Chicago IL, USA).The baseline data was measured using the one-sided t-test for Berg Balance scale and Amputee Mobility Predictor. Baseline was compared to cross check any discrepancies in the symptoms of both the groups and also to ensure that sampling had been done properly and the subjects are randomized well. The pre and post intervention measurements were compared using the paired sample t-test. The differences in the means were compared between the two groups using Independent samples t-test.The significance level was kept at α=0.05 (CI=95%).The graphs were prepared using Microsoft Excel for Mac Version 15.21.1 (2013) and the standard deviations were added to it.

RESULTS

Baseline Comparison of means within group A (PNF) and group B (AGILITY) after outcome measure

Group	Mean Age	Berg Balance Scale	Amputee Mobility Predictor	Sig (2 Tailed)
Group A	46.52	38.74	16.83	0.59
Group B	44.21	36.97	17.51	0.88

Total numbers of 30 unilateral transtibial amputee subjects were enrolled in the study. 30 completed the study with 15 each in group A (PNF Group) Group – B (AGILITY Group). The average age of the subjects in group A was 46.52 years and group-B was 44.21 years.

Table 1 Group A (PNF) Within group outcome measure

Outcome Measures	Pre-intervention	Post-intervention	Significance
Berg Balance Scale	38.74	50.17	0.00
Amputee Mobility Predictor	16.83	29.58	0.00

The result were found to be significant for both balance and mobility.

Table 2Group B (Agility)

Outcome Measures	Pre-intervention	Post-intervention	Significance
Berg Balance Scale	36.97	47.32	0.00
Amputee Mobility Predictor	17.51	25.67	0.00

The results were found to be significant for both the outcome measure of group B.

Table 3 Outcome measures of Between Group A and B

Outcome Measures	Group A Mean Difference	Group B mean difference	Significance
Berg Balance Scale	11.43	10.35	0.59
Amputee Mobility Predictor	12.75	8.16	0.01

The test results shows insignificant results for balance (p= 0.59) and significant results for mobility (p= 0.01).

Table 4 Post-intervention comparison of means between Group A& Group B

Group	Berg Balance Scale	Amputee Mobility Predictor	Sig (2 Tailed)
Group A (PNF)	50.17	29.58	0.04
Group B (AGILITY)	47.32	25.67	0.02

The test result shows significant result for Group A (p= 0.04) and very significant results for Group B (p= 0.02)

DISCUSSION

The hypothesis of the study was to compare the efficacy of PNF training vs AGILITY training on mobility and balance in unilateral transtibial amputee. The results are found to be significant for both the treatment methods. The group A(PNF training) showed significant results (p value=.04),and the group B(Agility training) showed significant results (p value=.02)[45]. The Group B (Agility training) showed more significant results as the P value was lesser than that of Group A(PNF training).Thus Agility training treatment method is more effective than the PNF training treatment method.

In the study agility training is more effective may be attributed to the fact that agility training put forth with a new definition of agility is purposed: "a rapid whole body movement with change of velocity of direction in response to a stimulus". Agility has relationship with trainable physical qualities such as strength, power and technique, as well as cognitive components such as visual scanning techniques, visual scanning speed and anticipation.

The results of the study is supported by another study by D. Vittas et al., (1986), stated that in amputee the postural sway is the main component affected and literature suggests that for a person to maintain balance requires coordination of input from multiple sensory systems including the vestibular, somatosensory and visual systems[46].

The objective of the study was to see the effect of Pnf training on mobility .The results indicate there is an improvement in mobility after pnf training. The p value is(p=.04).It is assumed that the improvement in mobility may be attributed to the fact that Proprioceptive neuromuscular facilitation improves the dynamic balance and overall mobility of patients. The said technique integrates manual contacts, verbal commands and vision to carry out, refine and improve muscle functioning and gait.

There is a significant increase of muscle strength of hip flexors, hip extensors, knee flexors and knee extensors of residual limbs of unilateral transtibial amputees of the group which received proprioceptive neuromuscular facilitation technique (PNF). The improvement in the group A can be attributed to improve mobility in the unilateral transtibial amputee.

This is supported by a study conducted by HadeyaAnjum(2016).[48] He concluded that the Proprioceptive neuromuscular facilitation technique was better in improving locomotion and functional status of people with transtibial amputation as compared to the traditional prosthetic strength training. The techniques were equally effective for improving step length, step width, and cadence in trans-tibial amputees.

The second objective of the study is to find the effect of pnf training on balance in unilateral transtibial amputees while walking. The results indicate there is an improvement in balance after pnf training. The p value is (p=.04).The improvement in balance may be attributed to the fact that Proprioceptive neuromuscular facilitation improves the dynamic balance hence it is also suitable to affirm that PNF training programme used in this study induced a response more related to and appropriate reaction to balance perturbation then to strength level improves.

The third objective of the study was to see the effect of Agility training on mobility. The p value is (p = 0.01), Taskin Mine et al., (2014) reported that the energy expenditure required to walk with a prosthesis is far higher than that required for an able-bodied person. In that study he found that a significant positive correlation existed between quickness with speed. Speed and quickness are important components of sport performance. Speed and quickness training is perfect for seniors because it will condition fitness aspects that are generally lost with age-speed and quickness.

The results of the study is supported by another study by GoranSporis et al. (2010), agility training could improve leg extensor power and the mobility of the person by improving muscle coordination. He concluded that agility training has a positive effect on movement technique and the ability to produce force in leg muscle more efficiently. These movements improve intra and inter-muscular coordination, which results in a better dynamic performance.

The results of the study is supported by another study by D.Vittas et al.(1986), stated that in amputee postural sway is the main component affected and literature suggest that for a person to maintain balance requires coordination of input from multiple sensory systems including the vestibular, somatosensory and visual systems[50].

The fourth objective of the study the effect of agility training on balance. The result indicates that there is the significant improvement in balance after agility training. The P value is (<.05). The study results is similar to another study by Warren B. Young et al.(2015), there he concluded that the cognitive element of the agility is the important for performance. Small side's games improve the agility of the patient. Development in the strength qualities and physical qualities improve the change of direction speed and balance.

CONCLUSION

The purpose of the current study was to compare the effect of Proprioceptive neuromuscular facilitation VS Agility training in unilateral transtibial amputee on mobility and balance. On the basis of the finding of the study, it can be concluded that both the Proprioceptive neuromuscular facilitation and Agility training both are effective in improving mobility and balance in unilateral transtibial amputee patient. But, conventional therapy along with Agility training yields more significant improvement in balance and mobility; than the Proprioceptive neuromuscular facilitation along with conventional occupational therapy. The Agility training has a key role to play in tailoring strategies and interventions to improve the balance and mobility in unilateral transtibial amputee patient.

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