



HIGH VS. LOW TENS AND GRADED EXERCISES: A PILOT STUDY ON PAIN AND FUNCTIONAL ABILITY IN PAD INDIVIDUALS

Physiotherapy

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ABSTRACT

Introduction And Purpose: Peripheral artery disease (PAD) is a progressive atherosclerotic condition causing insufficient blood flow to the lower extremities. Patients with PAD experience pain and cramping during ambulation due to intermittent claudication, affecting exercise performance, walking ability, and quality of life. This study aims to compare the effects of High and Low TENS and graded exercises on reducing pain and increasing walking distance in individuals with Grade II and III PAD. **Methodology:** This pilot study at SVIMS hospital included 20 individuals aged 30-60 years with medically managed PAD, an ABI below 0.9, and Leriche-Fontaine classification stage II. They were randomized into Group A (High TENS and graded exercises) and Group B (Low TENS and graded exercises). Baseline measurements of height, weight, BMI, six-minute walk test distance, and VAS scale claudication pain were recorded. Follow-up measurements were taken after 1 month. **Results:** ANOVA was used to analyze the data. All continuous data are described using mean (SE), with a P-value of <0.05 considered statistically significant. Group A showed a significant reduction in pain in the first and third months and a significant increase in walking distance in the third month. **Conclusion:** High TENS and graded exercises effectively reduce pain and increase walking distance in individuals with PAD treated medically.

KEYWORDS

Peripheral arterial disease, graded exercises, High TENS, Low TENS, six minutes walk test, pain .

INTRODUCTION

Peripheral artery disease (PAD) is a progressive atherosclerotic disease caused by insufficient arterial blood flow to the lower extremities (1, 2). It is a major complication of diabetes, associated with higher rates of morbidity and mortality (3, 4). PAD is increasingly prevalent in lower and middle-income countries (3, 4) with 2.2% of men and 1.2% of women diagnosed (5).

Patients with PAD experience aching and cramp-like pain in the lower extremity during ambulation due to intermittent claudication, affecting exercise performance and walking ability, leading to physical deconditioning and reduced quality of life (6, 7). The ankle-brachial pressure index is the most reliable measure to identify PAD (2). The disease severity is classified based on the Leriche-Fontaine classification.

With aging, the severity of PAD increases, resulting in a decrease in muscle mass, strength, and functional ability (15). Graded exercise interventions help revert these impairments, increase functional abilities, and improve physical fitness (10, 11, 12, 13, 14).

PAD limits blood flow to the legs, with intermittent claudication being a significant factor reducing walking distance and quality of life. Treatment includes modifying cardiovascular risk factors, pharmacological intervention, surgery, exercise therapy, and walking. Transcutaneous electrical nerve stimulation (TENS) is a safe, non-invasive method that helps alleviate pain from intermittent claudication, increasing walking distance and quality of life (8, 9).

The study aims to compare the effects of High and Low TENS and graded exercises on reducing pain and increasing walking distance in individuals with Grade II PAD. Despite numerous studies on walking and exercise for PAD symptom relief, few have assessed the association between High and Low TENS and graded exercises separately. Hence, this study evaluates the effectiveness of High and Low TENS and graded exercises in individuals with PAD.

METHODOLOGY:

The study was conducted at SVIMS Cardiovascular and Thoracic surgery department and approved by the SVIMS Institutional Ethical Committee (IEC.No.1179). Ten individuals aged 30-60 years, with BMI <27 , ABI <0.9 , and Leriche Fontaine classification stage II & III, who were clinically stable, were included. Exclusions were PAD with Coronary Artery Disease, ejection fraction $<40\%$, musculoskeletal disorders, neuromuscular disorders, myopathies, skeletal deformities, implants/pacemakers, progressive diseases causing general health

deterioration, and those unwilling to give consent. Eligible participants were randomly divided into two groups using a lottery method.

Group A

- High TENS (VECTROSTIM model) for 3 weeks
- Graded exercises (isometric for 3 weeks, isotonic for 3 weeks)
- Walking for 3 weeks

Group B

- Low TENS for 3 weeks
- Graded exercises (isometric for 3 weeks, isotonic for 3 weeks)
- Walking for 3 weeks

Anthropometric measurements, walking distance (six-minute walk test), and claudication pain (VAS scale) were measured at baseline, 1 month, and 3 months.

Statistical Analysis

Continuous data was assessed for normality and described using mean (SD). An ANOVA test was used to determine the significance, and differences between the two groups. A p value <0.05 (two-tailed) was considered statistically significant.

RESULTS:

Ten individuals with PAD of lower limbs who were medically managed were included in the study and randomly divided into two Groups A and B. Group A received High TENS and graded exercises, while group B received Low TENS and graded exercises. The baseline descriptives (Table 1) were mean age of the participants 51.70 ± 2.93 years, BMI 24.11 ± 0.43 Kgs/m², baseline pain 5.90 ± 0.31 and pain free walking distance 248.17 ± 19.03

Table 1: Descriptive Statistics

N=10	Mean	
	Statistic	Std. Error
Age	51.70	2.925
BMI	24.11	.43244
Pain	5.90	.314
Walking distance (WD)	248.17	19.03934

Pain Levels (VAS Scale): For Group A, pain levels (Table 2) decreased from 5.80 ± 4.76 at baseline to 4.20 ± 3.64 at month 1, and 2.00 ± 2.00 at month 3. Group B showed a reduction from 6.00 ± 4.48 at baseline to 5.00 ± 4.12 at month 1, and 3.00 ± 2.12 at month 3 (Figure 1).

Table 2: Comparison of pain and walking distance between groups

	Groups	Mean	Std. Error	F	P Value
Pain Baseline	GROUP A	5.80	4.76	0.07	0.93
	GROUP B	6.00	4.48		
Pain Month 1	GROUP A	4.20	3.64	4.67	0.03
	GROUP B	5.00	4.12		
Pain Month 3	GROUP A	2.00	2.00	9.75	0.00
	GROUP B	3.00	2.12		
WD - Baseline	GROUP A	238.05	149.92	0.15	0.86
	GROUP B	258.29	191.87		
WD - Month 1	GROUP A	498.50	337.94	2.64	0.11
	GROUP B	414.24	319.89		
WD Month 3	GROUP A	806.74	760.82	34.59	0.00
	GROUP B	533.31	393.57		

*. AP value of < 0.05 level is statistically significant .

Pain-Free Walking Distance (Six-Minute Walk Test): Group A's distances increased (Table 2) from 238.05±149.92 meters at baseline to 498.50±337.94 meters at month 1, and 806.74±760.82 meters at month 3. Group B's distances rose from 258.29±191.87 meters at baseline to 414.24±319.89 meters at month 1, and 533.31±393.57 meters at month 3 (Figure 2)

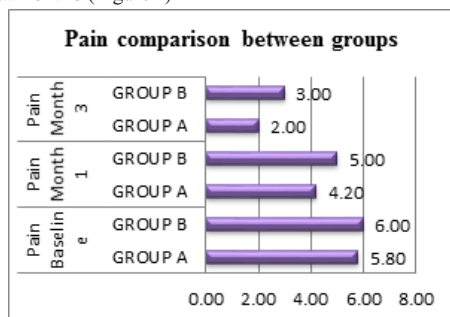


Figure-1: Comparison of pain between group A and Group B

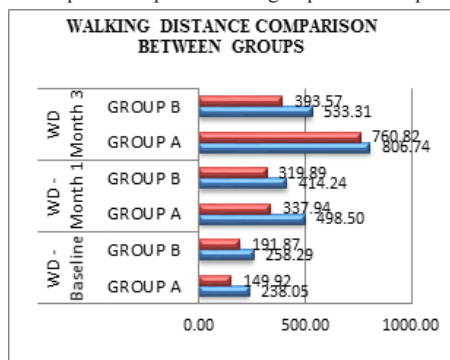


Figure-2: Comparison of pain free walking distance between group A and Group B

ANOVA Test Results: For Group A (High TENS + Graded exercises), a statistically significant reduction in pain was observed: $P=0.03$ and $F=4.67$ at month 1, and $P=0.00$ and $F=9.75$ at month 3. In contrast, Group B (Low TENS + Graded exercises) did not show such significant reductions.

Regarding pain-free walking distance, Group A had a statistically significant increase at month 3 with $P=0.00$ and $F=34.59$, but no significant change at month 1 ($P=0.11$ and $F=3.64$).

DISCUSSION :

This study shows that high TENS and graded exercises significantly improve pain and functional ability in individuals with peripheral arterial disease, compared to low TENS and graded exercises. Seenan et al. (16) reported increased walking distance with high TENS, but no significant pain reduction between high and low TENS groups. Labrunée et al. (17) found TENS delayed claudication pain onset and increased walking distance in both groups. Our study showed a greater reduction in pain and increased walking distance in the high TENS group.

Hatefi et al. (18) reported high TENS (80 Hz) effectively reduced chest

tube removal pain post-CABG when combined with cold compression. Sintean ME et al. (19) reported pain reduction with low TENS in femoropopliteal bypass surgery. Our study also showed greater pain reduction in the high TENS group.

Elboim-Gabyzon et al. (20) found high TENS (100 Hz) reduced pain and increased walking distance in post-operative hip fracture subjects. Our study observed a statistically significant increase in walking distance in the high TENS group compared to the low TENS group.

Limitations: Only participants were blinded. Uncontrolled factors like comorbidities, lifestyle factors, and medication use were not considered. Future research should address these limitations to enhance our understanding of TENS and exercise interventions for PAD patients.

CONCLUSIONS

This study examined the effects of high TENS and low TENS along with graded exercises on pain and walking distance in individuals with peripheral arterial disease. There was a significant decrease in pain, increase in walking distance in the group which received high TENS and graded exercises.

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