https://menj.journals.ekb.eg
Print ISSN: 2735-3974
Online ISSN: 2735-3982
DOI: ----------

MNJ
Menoufia Nursing Journal
Faculty of Nursing
Menoufia University

Effectiveness of Therapeutic Exercises Program on Pain and Functional Abilities among Patients with Plantar Fasciitis

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Abstract: Background: One of the most prevalent foot conditions is plantar fasciitis, which causes heel discomfort and can negatively affect a patient's overall and foot-specific health. Patients with this condition also tend to be less socially connected and have low energy levels to engage in activities. **Purpose**: To assess the effectiveness of a therapeutic exercise program on functional abilities and pain among patients with plantar fasciitis. **Methods**: A total of 62 individuals suffering from plantar fasciitis were included. Patients were allocated randomly into two equal groups; the study group and the control group. **Design**: A quasi experimental. **Instruments**: An organized demographic and Medical Data Sheet, Numerical Pain Rating Scales (NPRS). Foot Functional Index (FFI) and the American Orthopedic Foot and Ankle Society Scale (AOFAS). **Results**: After the intervention, there was a statistically significant difference between the two groups in favor of the study group for the NPRS score (P value = 0.0001), FFI score (P value = 0.000), and AOFAS score (P value = 0.000). **Conclusion**: The therapeutic exercise program reduces discomfort and improves foot function abilities in patients with plantar fasciitis. **Recommendations**: For individuals with plantar fasciitis, the exercise therapy program needs to be promoted as one of the key strategies for managing pain and improving foot functions.

***Key words**: Exercises therapeutic program, Functional Abilities, Pain; Plantar fasciitis.*

Introduction

Plantar fasciitis is a broad term for diseases including osseous and soft-tissue disorders that impact the heel and result in plantar heel discomfort (Gariani et al., 2020; Nadeem et al., 2023). The clinical diagnosis of PF is based only on the patient's history. The condition is characterized by pain on the medial plantar side of the heel that gets worse after resting, when the patient takes their first step in the morning, or when they perform weight-bearing activities. Walking may help with the pain at first, but it can get worse during the day. Since walking is a necessary component of daily activities (Rhim et al., 2021; Ríos-León et al., 2022).

PF results in significant functional disabilities, including discomfort and

rigidity in the feet. The discomfort brought on by PF has been associated with changes in gait, variations in stepping, and eventually internal rotation of the tibia and femur and modification of overall foot function (Gutteck et al., 2019). Patients with plantar fasciitis have significantly lower foot-specific and generic quality of life (QoL) than healthy individuals (Landorf et al., 2023).

There are numerous non-surgical methods for treating PF, including non-steroidal anti-inflammatory drugs (NSAIDs), cortisone injections, custom and prefabricated shoe inserts, night splints that extend the plantar fascia and Achilles tendon while sleeping, the use of casts, stretching exercises, and physical therapy (Caglar Okur & Aydin, 2019). Long-term outcomes from stretching exercises were superior to those from other treatments, like custom orthotics, night splint insertion, extracorporeal shock wave, ultrasound, iontophoresis, low-dye taping, anti-inflammatory drugs, corticosteroids, botulinum toxin, and platelet-rich plasma injections. Patients also benefitted from a low-cost method and the ability to practice independently anywhere. Additionally, it was discovered that stretching the plantar fascia and Achilles tendon simultaneously improved pain and ankle dorsiflexion twice as much as stretching the Achilles tendon alone (Engkananuwat et al., 2018).

Inappropriate management of plantar fasciitis can result in disability. Patient education is crucial. Nurses, physical therapists, and rehabilitation specialists play an essential role in preventing symptom recurrence. It is important to inform patients that improvement of the symptoms may take weeks or months. A physical treatment regimen and even night splinting may also be required for the patient (Palomo-López et al., 2018). It is necessary to instruct patients on how to stretch their plantar fascia at home using simple exercises. A podiatrist's consultation can also be necessary in order to obtain the right shoes with sufficient arch support. It is important to teach patients to avoid standing for extended periods of time. Additionally, it's crucial to stretch and lose weight before beginning an exercise routine. People who have severe symptoms should be advised to reduce repetitive activities that strain their heels and to avoid being barefoot (Uğurlar et al., 2018). Thus, the purpose of the current study was to assess how an eight-week therapeutic exercise program affects patients' functional abilities, discomfort, and outcomes related to plantar fasciitis.

Significance of the study

The most prevalent musculoskeletal condition affecting the feet is plantar fasciitis (PF), which affects between 24 and 65 individuals annually in a general practice clinic with 10,000 patients (Riel et al., 2019). Its prevalence ranges from 11% to 15% in the general population, affecting both young, energetic persons and older, sedentary people equally; however, it is more common in those between the ages of 40 and 60 (Hamstra-Wright et al., 2021). Furthermore, calcaneal spurs caused by avulsions are found in 38% of plantar fasciitis patients because of increased fascia tension

(Rhim et al., 2021). Plantar fasciitis causes chronic heel discomfort at its proximal insertion point, either accompanied or unaccompanied by inflammation (Hamstra-Wright et al., 2021).

There are major health benefits when the exercise treatment strategy is combined with other interventions like criotherapy and lifestyle adjustment. Its goal is to strengthen weakened tissues. Strengthening the soft tissues of the foot through moderate, repetitive exercise is an effective way to relieve heel pain. Stretching the soleus, gastrocnemius, and Achilles can help heal tissue and reduce adaptive risk factors for plantar fasciitis, which can be brought on by repetitive microtrauma (Kumar et al., 2021).

The initial course of treatment involves conservative approaches. Conservative treatment options include rest, soft shoes, insoles, exercises, and non-steroidal anti-inflammatory medication. When conservative treatment fails, patients may benefit from steroid or platelet-rich plasma injections, physical therapy modalities, extracorporeal shock wave therapy, and radiofrequency thermal ablation are commonly used. Surgical techniques may be employed in cases that do not respond well to conservative or minimally invasive treatments. Though, it can cause numerous complications, reducing pain and enhancing quality of life are the primary objectives of treatment (Hasegawa et al., 2020).

Purpose

To assess the effectiveness of a therapeutic exercise program on functional abilities and pain among patients with plantar fasciitis.

Research hypothesis

1) Patients with plantar fasciitis who follow the therapeutic exercise program (the study group) will experience less pain than those who don't (the control group).

2) Patients with plantar fasciitis who follow the therapeutic exercise program (the study group) will experience better foot function abilities than those who don't (the control group).

Methods

Research Design:

A quasi-experimental design, randomized control trial

Setting:

The present study was carried out at the University Hospital's orthopedic outpatient Clinic in Shebin EL-Kom City, Menoufia Governorate, Egypt.

Sampling technique

A purposive sample of 62 patients with a clinical diagnosis of plantar fasciitis, were selected from the aforementioned setting, agreed to partake in the study and met the requirements for inclusion. The participants were assigned randomly into two equal groups. For the purpose of randomization, an odd number was assigned to the study group and a double number to the control group..

In the procedure part: The inclusion criteria for the study sample were age range of 18–65 years, patients with painful tender heel, and pain that worsened in the morning and after prolonged standing or walking.

Participants were excluded if they were older than 65 years and had systemic inflammatory diseases, Diabetes mellitus, had corticosteroid injection for the heel in the past, had foot surgery, had other foot problems such as heel fat pad atrophy, calcaneal stress fractures or were unwilling to discontinue current treatment modalities as these conditions could affect the outcome of therapeutic exercise.

Sample Size Calculation

Slovin's Formula, which offers a sample size calculator utilizing the following values: confidence level, population size, and margin of error were used to calculate an appropriate sample size. Sixty-two patients were determined to be a sample size.

$$n = \frac{N}{1 + N(e)^2}$$

Where N is the overall population (72); e is the margin of error (0.05); and n is the sample size (61.017) = 62 according to the formula as follows:
n= 72/ [1+(72×(0.05)2] =61.017

Data Collection Instruments:

<u>Instrument one</u>: An organized demographic and Medical Data Sheet:

The instrument was developed by researcher to gather information on patients' age, sex, education level, telephone number, duration of suffering, body mass index, associated chronic conditions, affected leg (unilateral or bilateral), and duration of symptoms.

<u>Instrument two</u>: Numerical pain rating scales (NPRS).

It was developed by McCaffery, & Beebe, (1989). NPRS rates pain in intervals of ten, where zero denotes "no pain" and ten, "intolerable pain." The patients were asked to rate their level of pain on a scale from 1 to 10.
Scoring system: One to three indicates mild discomfort, four to six indicates moderate pain, and Seven to ten indicates severe pain. A score of zero indicates no pain. (Boonstra etal., 2016).

<u>Instrument three</u>: Foot Functional Index (FFI)

It was developed by Budiman et al. (1991) to assess how foot disease affects function in terms of pain, disability, and activity limitation. It contains 23 self-reported items, separated into three subscales: activity limitation (five questions), pain (nine questions), and disability (nine questions). Each item has a Likert scale rating between zero and ten. Zero indicates no pain or disability, ten represents the greatest pain, severe disability, and activity restrictions for each item. The subscale score was obtained by summing the item scores, dividing the result by the highest possible total score for the items, and multiplying by 100 (sum of the items of the score/maximum score of the subscale× 100). The instrument's total score is determined by adding together all items scores, dividing that total by the highest score of 230, and then multiplying the result by 100. (Total score / 230) x 100 = ___% is the

formula. The maximum score for the overall score is 100% (worst pain and significant difficulty requiring help), and the smallest value is 0% (no pain or trouble).

Instrument four: American Orthopedic Foot and Ankle Society Scale (AOFAS):

Kitaoka et al., (1997) developed AOFAS. It is used to assess how individuals with hind-foot or ankle issues are responding to therapy. It has two parts: one is reported by the patient and the other by the doctor. The AOFAS is a 9-item questionnaire classified into three subscales: 1) level of pain consists of 1 item and its score ranges from 0 to 40; 40 points = no pain and 0 points = severe pain; 2) function consists of 7 items (Activity limitations, support requirements, maximum continuous walking distance, walking surface, gait abnormalities, sagittal motion, hind foot motion, ankle hind-foot stability), and its score ranges from 0 (severe function impairment score) to 50 points (full function score); and 3) foot alignment consists of 1 item; its score ranges from 0 to 10 points; good alignment of ankle and foot equals 10 points and zero indicates severe mal-alignment, symptoms. It was used for measuring functional recovery after different foot and ankle problems. The total score of the scale ranged from 0 to 100 points; (0) indicates the worst, and (100) shows no symptoms or impairments.

Validity

Five experts from Menoufia University—two medical professors and three professors from the Faculty of Nursing's Adult Health Nursing Department—determined the content and face validity of the instruments. Instruments were reviewed for topic coverage, clarity, phrasing, length, structure, and overall appearance.

Reliability:

Reliability of instrument one was determined by researchers using the test and retest method and the Pearson correlation coefficient formula; the r value was 0.81. The reliability of instrument two was tested by Alghadir et al., (2018), who proved that it is excellent and reliable, to measure pain for osteoarthritis of the knee with intraclass correlation coefficients equal to 0.95. Budiman et al., (1991) tested the reliability of instrument 3 and found that the FFI sub-scale scores and overall scores showed test-retest reliability ranging from 0.87 to 0.69. Internal consistency ranged from 0.96 to 0.73. The instrument four was tested for reliability by Tan et al., (2022), who reported that the AOFAS demonstrated excellent reliability with a Cronbach α of 0.837.

Ethical considerations and human rights

Approval of Menoufia University Faculty of Nursing's Ethical and Research Committee (approved number 930) was obtained. Every participant agreed that the information they provided would only be utilized for research purposes.. A formal consent for their agreement to share in the study was obtained by participants and they were informed that the

methods would not cause any harm to them. Furthermore, the researchers assured them that the privacy of their information would be protected and their involvement in the study was completely optional. The patients were also told that declining to participate in the study would not have an impact on their care. Participants were also told that declining to participate in the study would not have an impact on their care.

Pilot study

Prior to data collection, pilot research, including six patients (10%), was conducted to assess the objectivity, clarity, application, and practicality of all instruments. Prior to making the appropriate adjustments, it was also done to quantify the amount of time needed for data collection and to find any issues related to using the tools.

Procedure:

An official letter was submitted from the Dean of the Faculty of Nursing, Menoufia University to the director of the director of university hospitals An official letter was submitted from the Dean of the Faculty of Nursing, Menoufia University to the director of university hospitals explaining the purpose of the study and methods of data collection.

Data were collected over a 6-month period, starting at the beginning of March 2023 to the end of 15 September 2023. The researchers conducted interviews with participants who met the requirements for inclusion criteria and clarified the purpose of research. Then data was gathered using the designed questionnaires. Sixty-two patients with plantar fasciitis were assigned randomly into 2 equal groups, each with 31 patients.

Before beginning the exercise therapy program, patients in the two groups were personally interviewed by the researchers in the orthopedic outpatients' clinic. Baseline data were obtained through socio-demographic and medical questionnaires. Then, NPRs instrument was used to assess pain. Both FFI and AOFAS to assess foot functional abilities.

All patients in the two groups were asked to follow standard hospital treatment that included rest for two weeks, non-steroidal anti-inflammatory drugs for three weeks, use of prefabricated full-length soft insole instructions, and criotherapy through rolling the foot over a frozen bottle early in the morning and after an extended period of rest or standing

The study group was instructed to follow a therapeutic exercise program for eight weeks beside standard hospital treatment. They were instructed to do two types of exercises: plantar fascia stretching with massage and Achilles tendon stretching. The therapeutic exercise program was carried out according to Balasubramaniam & Kumar, (2019).

Therefore, a face-to-face educational session was conducted for each patient in the study group to provide full explanations for the steps of exercises and allow demonstrations until the patient became able to conduct the recommended exercises in the correct way. The session lasted around 15 to 20 minutes. Each patient in the study

group was given an exercise adherence logbook at the conclusion of the session. This was done by the researchers to ensure that the patients could adhere to the therapeutic exercise program. It consisted of a weekly workout sheet for eight weeks of follow-up. The research participants were contacted once a week by phone calls or during outpatient visits for follow-up.

After eight weeks, pain levels and foot functional abilities were evaluated in the two groups using study tools. The pre- and post-intervention data were compared between the study and control groups to achieve the study's goal.

Figure (1) plantar fascia tissue-stretching and massage demonstrated

Exercise one was plantar fascia tissue-stretching and massage (demonstrated as shown in Figure 1). The patient in the intervention group was asked to cross the afflicted leg over the contralateral leg while putting the fingers of the same hand over the base of the toes. The patient then pulled the toes back toward the shin until the plantar fascia, or arch, felt stretched. By feeling for tightness in the plantar fascia, the patient verified that the stretching was effective. Next, they applied firm pressure to the foot's sole and massaged it deeply for ten seconds. This step was repeated ten times in total. This exercise was conducted two to three times a day. The first time before rising from sleep. It is also beneficial after extended hours of sitting.

Exercise (2): Achilles tendon stretching

Exercise two was Achilles tendon stretching was demonstrated in figure 2. The participants in the research group were asked to sit on the floor with their legs extended in front of them. Then, they had to wrap a towel, rope, or band around their foot, pull it to stretch their calf, and hold it for 30 seconds. Afterwards, they were asked to release the tension. This exercise

was repeated three times a day. It was performed after exercise one.

Patients in the control group only received standard hospital treatment that included rest for two weeks, non-steroidal anti-inflammatory drugs for 3 weeks, rest for two weeks, a criotherapy and education about low shoes and the use of soft insoles

After eight weeks, pain levels and foot functional abilities were evaluated in the two groups using study instruments two, three, and four.

Data Analysis

Statistical Package for Social Science version 25 for Windows was used to tabulate the data and perform statistical analysis. The qualitative data was presented as frequencies and percentages for each category. In order to compare the means of two groups of parametric data, an independent t-test was performed for quantitative data; a P-value of 0.05 was used as the level of significance. A statistically significant difference was considered if P<05, a highly statistically significant difference was considered if P <0.001.

Results

Table 1 reveals the demographic and medical data of patients in the study and control groups. It was clear that the majority of the sample (70.97% of the study group and 64.55% of the control group) were females. The means and standard deviations of age for the study and control groups were 43.7±11.244.2±10.99 respectively. About half of the studied patients in the study and control groups had secondary education. Most of them in both groups had work (67.74% of the study group and 64.52% of the control group). The unilateral foot affection was found in 74.19% of the study group and 67.74% of the control group. The mean BMI was 32.8 and 33.7, respectively, for the study and control groups.. All study patients feel pain in the morning after waking up and after prolonged walking or standing.

Table 2 shows that there was no statistical significant difference between the two groups before intervention. Conversely, post-intervention, a highly statistical significant reduction in the mean score of the pain was found in favor of the study group, where the p value was to 0.001 and the mean ± SD post-intervention was 1.484 ±0.741 for the intervention group and 4.12 ± 0.756 for the control group.

Figure 1:- shows that before intervention, 64.52% and 35.48% of the study group and 61.9% and 38.71% of the control group, respectively, reported moderate and severe pain. Conversely, after the intervention, the study group reported that 74.19% had mild pain, whereas 28.81% had mild pain, respectively, whereas. In the same time, 29.03%, 54.84%, and 16.13% of the control group reported suffering from mild pain, moderate and severe pain respectively.

Table 3:- clarifies mean scores of FFI and its Subscales (pain, disability and activity Limitation) before and after intervention among patients in the study and control groups. A highly significant statistical improvement in the foot's function in terms of pain, disability, and activity restriction was

found after intervention in the study group compared to the control group, where the p value = 0.000 for the mean score of the scale and all subscales. The means and standard deviations for the FFI and its subscales for the study and control groups, respectively, post-intervention were 11.50±1.54 and 36.51±5.27 for the FFI, 10.63±2.01 and 33.64±7.98 for pain, 12.34±2.30 and 38.66 ± 5.3 for disability, and 11.52±2.01 and 37.33±5.27 for activity limitation.

Table 4: The data presented in the table indicates that the mean score of the AOFAS and its subscales (pain, function and foot alignment) before and after intervention among patients in the study and control groups. The mean scores for the AOFAS and its subscales after intervention for the study and control groups, respectively, were: 87.03±12.97 and 56.97±15.27 for the AOFAS; 33.53±8.51 and 22.76 ±9.98 for pain; 43.48±5.76 and 26.98 ± 8.31 for function; and 10±0 and 7.23±1.21 for foot alignment. The p values post-intervention were 0.000 and 0. 0001 For this reason, a highly statistical significant difference was found (P<.001).

Table (1): Distribution of Patients in the Study and Control Groups According to Demographic and Medical data (n= 62).

Variables	Study Group (no= 31)		Control Group (no= 31)		P value
	No.	%	No.	%	
Age (years):					
○ X ± SD	43.7±11.2		44.2±10.99		0.93
○ Range	(34- 60)		(36- 59)		
Gender					
○ Male	9	29.03	11	35.48	0.65
○ Female	22	70.97	20	64.52	
Education level					
○ Read and write	5	16.13	6	19.35	
○ Primary education	6	19.35	5	16.13	0.79
○ Secondary education	15	48.39	14	45.17	
○ High education	5	16.13	6	19.35	
Occupation:					
○ Work	21	67.74	20	64.52	0.52
○ Not work	10	32.26	11	35.48	
Side involvement:					
○ Bilateral	8	25.81	10	32.26	0.63
○ unilateral	23	74.19	21	67.74	
Body mass index (kg/m2)					
○ (Mean ± SD)	(32.8± 4.2)		(33.7± 4.2)		0.65
○ Range	(28.6- 38.90)		(27.6- 37.95)		
Characters of pain					
○ After waking up	31	100	31	100	
○ While running	8	25.81	9	29.03	
○ following extended walking or standing	31	100	31	100	0.21
○ Following extended sitting	16	51.61	14	45.16	

Table (2): Mean of Pain Scores Before and After Intervention among Study and Control Groups (n= 62)

Variables	Study Group $\bar{x} \pm SD$	Control Group $\bar{x} \pm SD$	Independent t-test P value
Score of pain before intervention	6.24 ±1.11	6.5 ± 1.03	p = 0.21
Score of pain post-intervention	1.484 ±0.741	4.12 ± 0.756	p =0 .0001**

Figure (1) Distrbution of Pain Categories among Study and Control Group Based on Numiricale Pain Scale Baseline and Post Intervention

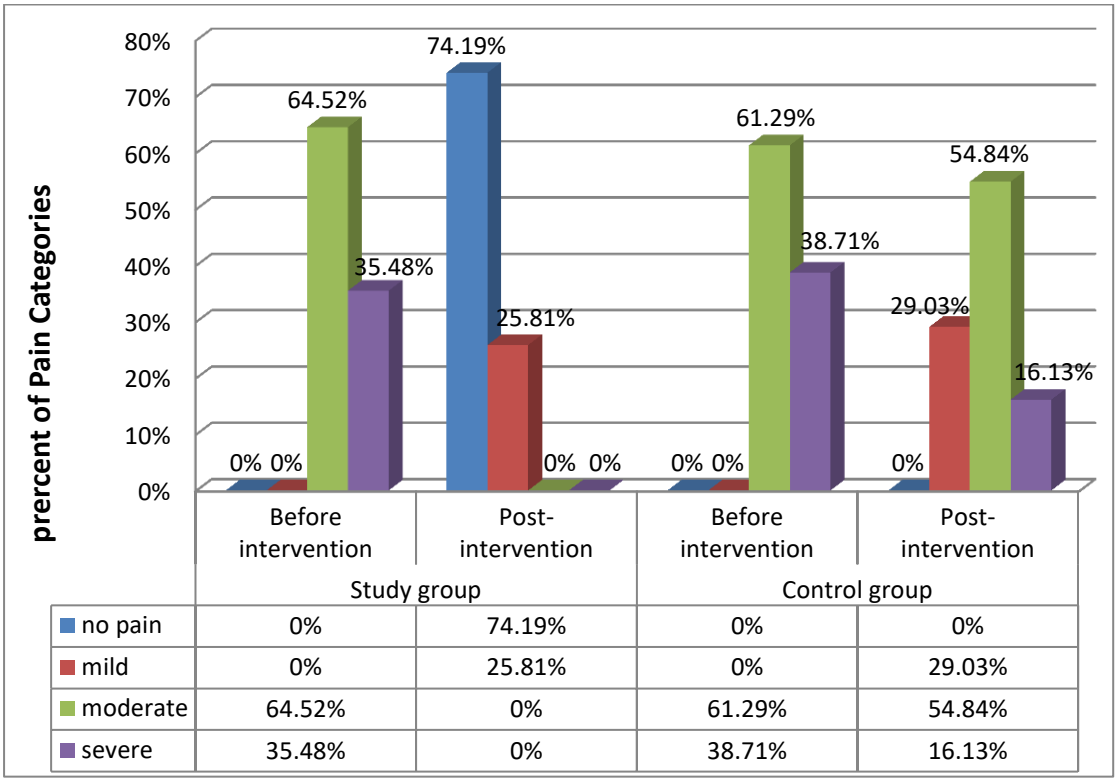

Table 3: Mean Score of FFI and Its Subscale among Subjects of Study and Control Groups before and after Intervention (n= 62).

variables	Study group (n=31) $\bar{x} \pm SD$	Control group (n=31) $\bar{x} \pm SD$	Independent t-test P value
Pain			
▪ Before intervention	63.55±8.70	62.44±7.88	0.61
▪ Post-intervention	10.63±2.01	33.64 ± 7.98	0.000**
Disability			
▪ Before intervention	64.68±7.18	65.37±6.34	0,51
▪ Post-intervention	12.34±2.30	38.66 ± 5.3	0.000**
Activity Limitation			
▪ Before intervention	64.36±7.33	63.45±7.33	0.49
▪ Post-intervention	11.52±2.01	37.23±5.33	0.001**
Total Score of FFI			
▪ Post-intervention	64.19±5.94	63.75 ± 4.33	0.54
▪ After intervention	11.50±1.54	36.51 ± 5.27	0.000**

Table 4: Mean Score of the AOFAS and Its Subscales among Subjects of Study and Control Groups before and after Intervention (n= 62).

variables	Study group (n=31)	Control group (n=31)	Independent t-test P value
	x̄ ±SD	x̄ ±SD	
Pain			
▪ Before intervention	18.23±12.48	19.55±11.88	0.91
▪ Post-intervention	33.53±8.51	22.76 ±9.98	0.000**
Function			
▪ Before intervention	19.71±3.72	18.43±4.34	0.38
▪ Post-intervention	43.48±5.76	26.98 ± 8.31	0.000**
Foot alignment			
▪ Before intervention	7.74±2.51	6.32±3.21	0.32
▪ Post-intervention	10± 0	7.23±1.21	0.0001*
Total Score of AOFAS			
▪ Before intervention	45.68±17.08	44.30 ± 16.33	0.96
▪ Post-intervention	87.03± 12.97	56.97 ± 15.27	0.000**

Discussion

Plantar fasciitis is one of the most common conditions in the orthopedic sector. In spite of this, very little progress has been made in understanding and treating this condition. There is no conventional treatment plan for plantar fasciitis. Patients have access to a wide range of management choices. In 90% of people with plantar fasciitis, non-operative treatment results in total pain remission, though it may take two to three months. (Latt et al., 2020). In this study the researchers introduced a therapeutic exercise program as an additional treatment modality and examine its effect on pain control and foot functional abilities in patients with planter fasciitis. The discussion of the study's findings will take place in the following order:

As regards The effect of the therapeutic exercise program on pain, the current study showed a significant statistical reduction in the mean score of the NRPS in favor of the study group. These results are in congruence with Pearce et al., (2021), who reported a statistically significant relationship between the degree of plantar fasciitis-related foot pain and the tightness of the gastrocnemius, indicating that stretching exercises for the gastrocnemius should be the within the main course of treatment. This finding was also in the same line with Abdelmowla & Abd-Elmageed (2021), who clarified that the intervention group that received the exercise program showed a significant decrease in the score of the NRPS at two and three months after the application of the twelve-week exercise rehabilitation program.

With reference to the effect of the therapeutic exercise program on the functional abilities of the foot: the current study showed that, there was a highly significant statistical improvement in the foot function Index score in terms of pain, disability, and activity restriction, the AOFAS score

after intervention of exercise program. This finding is consistent with Kumar et al., (2021) and Alshammari et al., (2023), they reported that there are several health advantages to exercise therapy techniques. It aims to strengthen harmed tissues. Strengthening the soft tissues of the foot through moderate, repetitive exercise is an effective way to relieve heel pain. The soleus, gastrocnemius, and Achilles flexed during slow strengthening activities may stretch the tissue and reduce adaptive risk factors for plantar fasciitis, which may be brought on by recurring microtrauma. The study findings are similar to Abdelmowla & Abd-Elmageed (2021), who clarified that the intervention group that received the exercise program showed significant improvements in pain, functional recovery and foot function that were expressed in a reduction of the FFI score and an increase in the AOFAS score in terms of intermediate (two months) and final measurements (three months) after application of the twelve-week exercise rehabilitation program.

The same results were stated by Balasubramaniam & Kumar, 2019, when they tested the effect of cryotherapy versus cryotherapy along with dynamic calf and plantar fascia stretching among ramblers for a period of eight weeks. They reported that the criodynamic stretch group showed significant improvements in the scores of the NPRS and FFI. Also, Yadav et al., (2022) reported that self-stretching and foam rolling can help people with plantar fasciitis reduce pain and improve range of motion and joint mobility.

The results of the current study clarified that the study group showed significant improvements in pain, functional recovery and foot function (NPRS, AOFAS and FFI scores) after application of the therapeutic exercise program. From the researchers' point of view, this may be due to the application of therapeutic exercise by the study group, which decreased pain and enhanced functional recovery and foot function. Plantar fasciitis patients responded well to the therapeutic exercise regimen, which facilitated a speedy recovery and improved patient outcomes. This study result is consistent with Thong-On et al. (2019), who conducted a strengthening and stretching exercise program that significantly improved pain and gait function for patients with plantar fasciitis compared to assessment data. The morning pain and the worst pain were reduced in both groups, and significant improvement was observed with regard to the visual analogue scale score.

In this study, patients in the study group showed greater improvements in FFI scores (foot function) and AOFAS scores (functional recovery) than the control group during the follow-up period. From the researchers' point of view, this might have happened as a result of the therapeutic exercise program's significant advantages for those with plantar fasciitis. Additionally, the improvement observed in the study group might have been due to enhanced dorsiflexion of the plantar flexors and ankle range of

motion through strengthening and stretching exercises for the calf muscles and Achilles tendon. In addition, the researchers' ongoing monitoring of the intervention group ensures that the patients are adhering to the instructions in the handout they were given, which call for frequent exercise performance.

Nurses are crucial in addressing each patient's demands, promoting their function, and assisting them in determining how to carry out everyday tasks. Patients' motivation, quality of life, and physical function all improve as a result of their identification of each patient's unique needs and provision of the required care and education. Additionally, they play a significant and useful role in patients adhering to the treatment plan (Kwon & Lee, 2017).

Conclusions:

According to the study's findings, it can be concluded that patients with plantar fasciitis can experience less pain and better foot function by participating in a therapeutic exercise program that includes rolling the plantar fascia with a frozen water bottle, stretching the Achilles tendon, and stretching the plantar fascia.. Rehabilitation nurses play a crucial and successful role in helping patients with plantar fasciitis by providing ongoing education, supervision, and training. These efforts also help patients adhere to their exercise regimens and achieve better results.

Recommendations:

Patients with plantar fasciitis can greatly benefit from patient education about the exercise's rehabilitation program (plantar fascia stretching, Achilles tendon stretching and rolling the plantar fascia with a frozen water bottle). The exercise program should also be promoted as one of the important modalities to control the pain and improve functional recovery and foot function for patients with plantar fasciitis.

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