STUDY TO SEE THE EFFECT OF PHYSIOLTHERAPY WITH OR WITHOUT METATARSAL PADS IN SECURITY GUARDS HAVING METATARSALGIA

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Abstract

Background The term metatarsalgia is acquired from a Greek word that describes pain beneath metatarsal heads at the plantar aspect of the foot. The pain under one or more metatarsal heads is designated as metatarsalgia. The forces applied to the forefoot can cause metatarsalgia of different severity. Metatarsalgia is a general term used to describe pain under one or more metatarsal heads. Metatarsalgia describes the location of pain rather than underlying cause and type of pain. It is the most common foot complaints in different people. In most of the patients the pain causes exasperation and irritation. The most common causes such as skin problems beneath the metatarsal heads, disorders of metatarsophalangeal joint, interdigital neuroma, systemic and structural disorders, trauma and sesamoiditis are discussed in metatarsalgia

Study design RCT

Methodology Randomize control trial was used to determine the correlation between plantar pressure parameters and subjective treatment effects among security guards of Multan having metatarsalgiaData was collected from security guards of various sectors of Multan. The study was completed in 24 weeks after approval of synopsis. Non-probability convenient sampling technique was to recruit the individuals for study. The sample size was calculated by using Raosoft calculator

Results The socio-demographic variables of the sample population were analyzed and the following information was obtained. Out of the total sample size of 38 participants, individuals (53.5%) reported experiencing metatarsalgea, a condition characterized by pain in the metatarsal area of the foot. Among those who experienced metatarsalgea, participants (46.5%) reported using pads as a means of managing the pain. In terms of gender distribution, there were no female participants in the sample, while male participants (35%) were included in the study. Regarding marital status, individuals (46%) reported being married, whereas participants (54%) stated that they were not married. The participants were also assessed for straight leg raise (SLR) test results on the right and left sides. For the right side, participants (92.5%) had a positive SLR test, indicating the presence of pain or restriction of movement during the test. On the other hand, participants (7.5%) had a negative SLR test, indicating no pain or restriction of movement during the test. For the left side, participants (88%) had a positive SLR test, while participants (12%) had a negative SLR test. These socio-demographic variables provide an overview of the

characteristics of the sample population and can be useful in understanding the distribution and associations of metatarsalgea, gender, marital status, and SLR test results in the study.

Conclusion This study was conducted to determine the physical therapy treatment with metatarsal pad is an effective method to reduce pressure loading under the metatarsal head and relief the symptoms of metatarsalgia

Introduction:

The term metatarsalgia is acquired from a Greek word that describes pain beneath metatarsal heads at the plantar aspect of the foot. The pain under one or more metatarsal heads is designated as metatarsalgia. The forces applied to the forefoot can cause metatarsalgia of different severity. [1]

Metatarsalgia is a general term used to describe pain under one or more metatarsal heads. Metatarsalgia describes the location of pain rather than underlying cause and type of pain. It is the most common foot complaints in different people. In most of the patients the pain causes exasperation and irritation.The most common causes such as skin problems beneath the metatarsal heads, disorders of metatarsophalangeal joint, interdigital neuroma, systemic and structural disorders, trauma and sesamoiditis are discussed in metatarsalgia.[1]

The pain in metatarsal plantar aspect of foot is termed as metatarsalgia.It exists in three general forms: generalized metatarsal pain, pain in first metatarsal head region and metatarsalgia of fourth lateral metatarsal head region. It is the symptom of many under laying causes and other contributing factors and not a particular diagnosis of any specific pathology. This concept might seem simple but complaint can be anything a disease or any other deformity such as fractures.[2] Metatarsalgia is a common foot condition characterized by pain and inflammation in the ball of the foot, specifically the metatarsal region. It is a prevalent foot problem that affects people of all ages and activity levels. The condition can significantly impact an individual's mobility, causing discomfort and limiting their ability to engage in daily activities. This article aims to provide a comprehensive overview of metatarsalgia, including its causes, symptoms, diagnosis, and available treatment options. To understand metatarsalgia, it is essential to first grasp the anatomy and function of the metatarsal region. The metatarsals are a group of long bones located in the middle of the foot, connecting the toes to the midfoot. They play a crucial role in weight-bearing and maintaining balance during walking, running, and other weight-bearing activities. Metatarsalgia can be caused by various factors, including mechanical, systemic, traumatic, and inflammatory conditions. Mechanical factors such as high-impact activities, ill-fitting footwear, and foot deformities can contribute to the development of metatarsalgia. Systemic conditions like rheumatoid arthritis, gout, and diabetes can also increase the risk of developing the condition. Additionally, trauma to the foot, such as fractures or repetitive stress injuries, can lead to

metatarsalgia. The primary symptom of metatarsalgia is pain in the ball of the foot, which can vary in intensity and location. The pain is often described as a burning, aching, or sharp sensation. Other symptoms may include numbness, tingling, and the feeling of having a pebble in the shoe. The pain is typically aggravated by weight-bearing activities and improves with rest. Diagnosing metatarsalgia involves a thorough physical examination, medical history assessment, and possibly imaging tests. During the examination, the healthcare provider will evaluate the patient's foot structure, gait, and assess areas of tenderness. [3]

Plantar plate repair damage to the plantar plate can be accurately assessed using arthrography and, more recently, MRI or ultrasonography. Primary plantar plate repair can be performed through a curved plantar incision . The flexor tendon sheath is incised and the plantar plate tears are sutured. Few studies have evaluated the outcomes of this procedure [4]. Nevertheless, this technique may be helpful in selected patients with MTP joint instability but no dislocation. Plantar plate repair by suturing or tenodesis to the base of P1 can be combined with a shortening metatarsal osteotomy via a dorsal approach. The limited exposure raises technical challenges. This repair method probably improves the outcomes of Weil osteotomyin patients with MTP joint dislocation

Material and Methods:

Study Design

Randomize control trial was used to determine the correlation between plantar pressure parameters and subjective treatment effects among security guards of Multan having metatarsalgia

Study Setting

Data was collected from Azeem hospital of Multan.

Duration of Study

The study was completed in 24 weeks after approval of synopsis.

Sample Technique

Non-probability convenient sampling technique was to recruit the individuals for study.

Sample Size

The sample size was calculated by using Raosoft calculator [5] that is 36.

The sample size n and margin of error E are given by

$$x = Z(c/100)2r(100-r)$$

$$n = N\,x/((N-1)E2 + x)$$

$$E = Sqrt[(N - n)x/n(N-1)]$$

where N is the population size,

r is the fraction of responses that you are interested in, and

Z(c/100) is the critical value for the confidence level c.

With a confidence level of	90	95	99
Your sample size would need to be	**26**	**42**	**62**

5.6 Sample Collection Criteria

Inclusion Criteria

- Only male security guards
- Age group 25-65 years
- Standing more than 4 hours daily on duty
- Wearing hard shoes
- Willing to participate
- Having metatarsal pain

Exclusion criteria

- Diabetic patients
- Any neurological deficit
- Congenital disease
- Fracture of tarsal bones
- Plantar fasciitis
- Not willing to participate or leave protocol during protocol

Data Collection Procedure

After permission from the ethical review committee, Informed consent was taken from each patient and data was collected from participants through questionnaire. There were two groups and the participants allocation was done by lottery method. One group was treated by subjective treatment and other were treated by subjective and MP placement.

Results:

. Demographic data:

Table 1: Demographic data of individuals with and without chronic NSLBP.

Socio Demographic Variables	Description	value
Sample	Metatarsalgea	20 (53.5)

	With pads	18 (46.5)
Gender	Female	0 (0)
	Male	38 (35)
Married	Yes	18(46)
	No	20 (54)
SLR(R) before applying pad	Positive	32(92.5)
	Negative	6 (7.5)
SLR(L) before applying pad	Positive	28(88)
	Negative	11(12)
SLR(R) after applying pad	Negative	32(92.5)
	Positive	6 (7.5)
SLR(L) after applying pad	Negative	28(88)
	Positive	11(12)

NOTE: n: number of participants, %: percentage

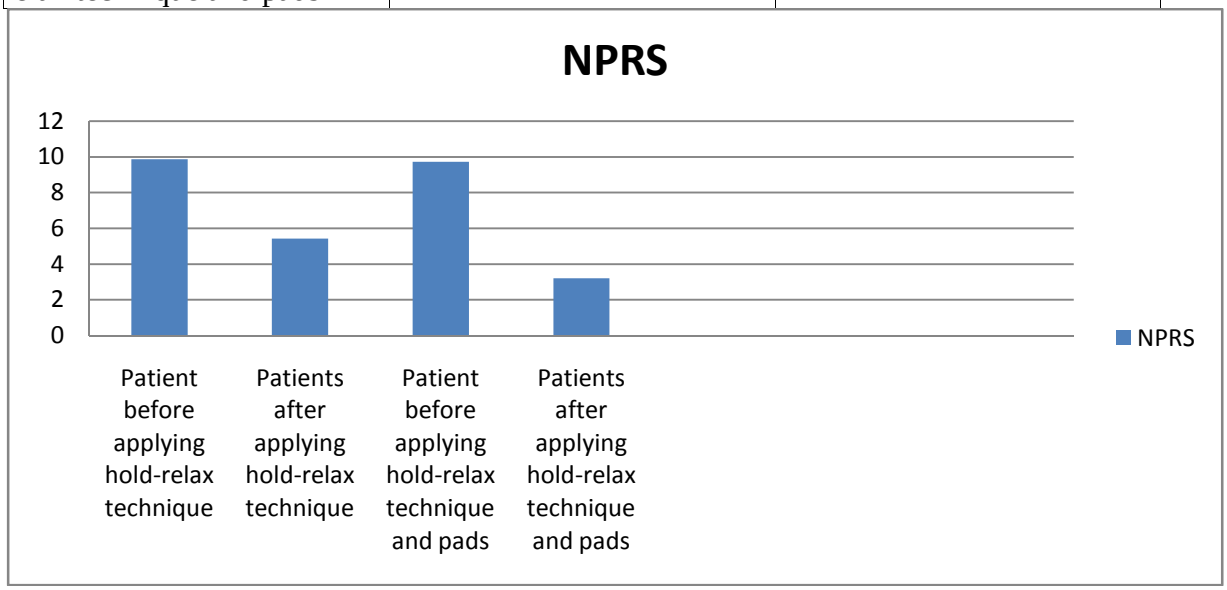
The socio-demographic variables of the sample population were analyzed and the following information was obtained. Out of the total sample size of 38 participants, individuals (53.5%) reported experiencing metatarsalgea, a condition characterized by pain in the metatarsal area of the foot. Among those who experienced metatarsalgea, participants (46.5%) reported using pads as a means of managing the pain. In terms of gender distribution, there were no female participants in the sample, while male participants (35%) were included in the study. Regarding marital status, individuals (46%) reported being married, whereas participants (54%) stated that they were not married. The participants were also assessed for straight leg raise (SLR) test results on the right and left sides. For the right side, participants (92.5%) had a positive SLR test,

indicating the presence of pain or restriction of movement during the test. On the other hand, participants (7.5%) had a negative SLR test, indicating no pain or restriction of movement during the test. For the left side, participants (88%) had a positive SLR test, while participants (12%) had a negative SLR test. These socio-demographic variables provide an overview of the characteristics of the sample population and can be useful in understanding the distribution and associations of metatarsalgea, gender, marital status, and SLR test results in the study.

Effect of treatment with NPRS

Variable	Mean ± SD	p-value
Patient before applying hold-relax technique	9.87±1.42	0.67
Patients after applying hold-relax technique	5.42±0.48	0.04

Variable	Mean ± SD	p-value
Patient before applying hold-relax technique and pads	9.73±1.51	0.64
Patients after applying hold-relax technique and pads	3.21±0.24	0.02

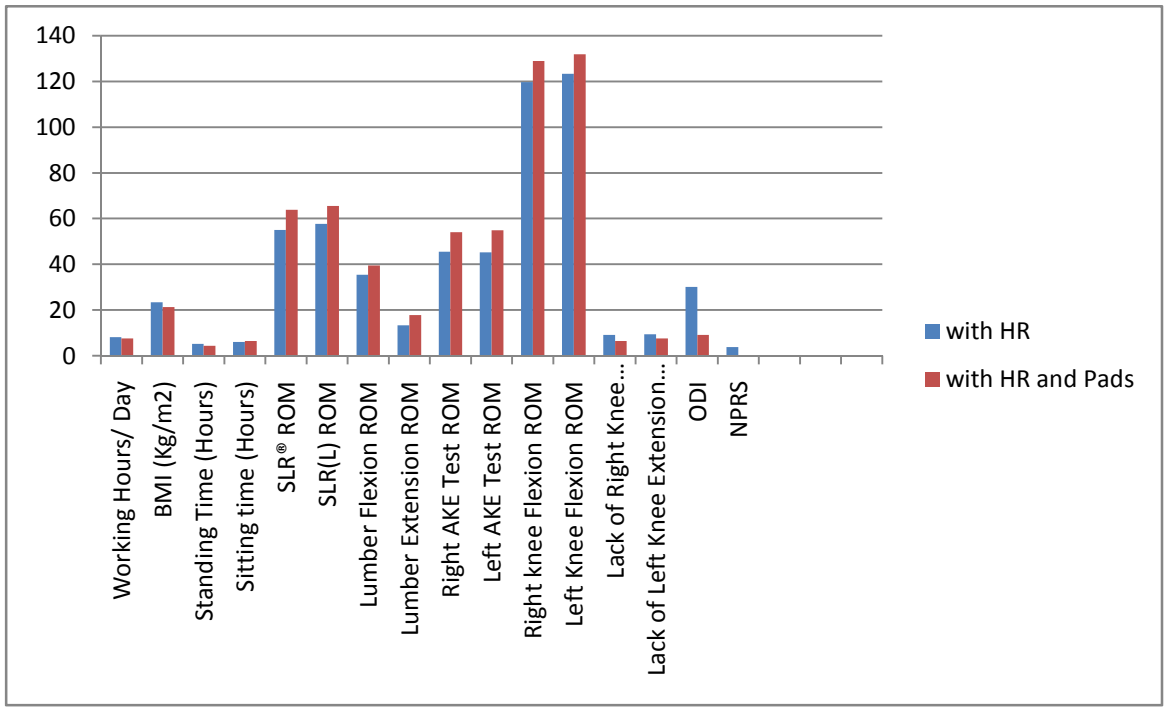


The Effect of Metatarsalgea with Descriptive Variables

Table 2:The Association of Metatarsalgea with Descriptive Variables

Variables	With hold-relax technique (n=19) (Mean ± SD)	With Pads and conventional method (n=19) (Mean ± SD)	X^2	p-value
Working Hours/ Day	8.06 ± 3.01	7.63 ± 3.03	12.669	0.0021
BMI (Kg/m^2)	23.39 ± 3.42	21.31 ± 3.25	30.294	0.0024
Standing Time (Hours)	5.12 ± 1.87	4.38 ± 1.62	14.518	0.0032
Sitting time (Hours)	6.05 ± 2.08	6.44 ± 2.61	20.108	0.044
SLR® ROM	55.09 ± 11.07	63.87 ± 13.89	37.163	0.000
SLR(L) ROM	57.71 ± 11.51	65.59 ± 12.62	29.799	0.003
Lumber Flexion ROM	35.47 ± 10.04	39.52 ± 8.51	33.712	0.000
Lumber Extension ROM	13.36 ± 4.51	17.77 ± 4.34	42.650	0.000
Right AKE Test ROM	45.51 ± 12.94	54.03 ± 17.17	51.190	0.000
Left AKE Test ROM	45.19 ± 12.95	54.95 ± 17.76	56.294	0.000
Right knee Flexion ROM	119.68 ± 10.18	128.98 ± 10.52	72.537	0.000
Left Knee Flexion ROM	123.36 ± 10.41	131.83 ± 11.46	53.119	0.000
Lack of Right Knee Extension ROM	9.04 ± 3.95	6.50 ± 2.17	30.644	0.000
Lack of Left Knee Extension ROM	9.41 ± 3.87	7.68 ± 2.56	30.458	0.000
ODI	30.11 ± 9.81	9.15 ± 6.54	162.689	0.000
NPRS	3.78 ± 1.28	0.054 ± 0.27	196.172	0.000

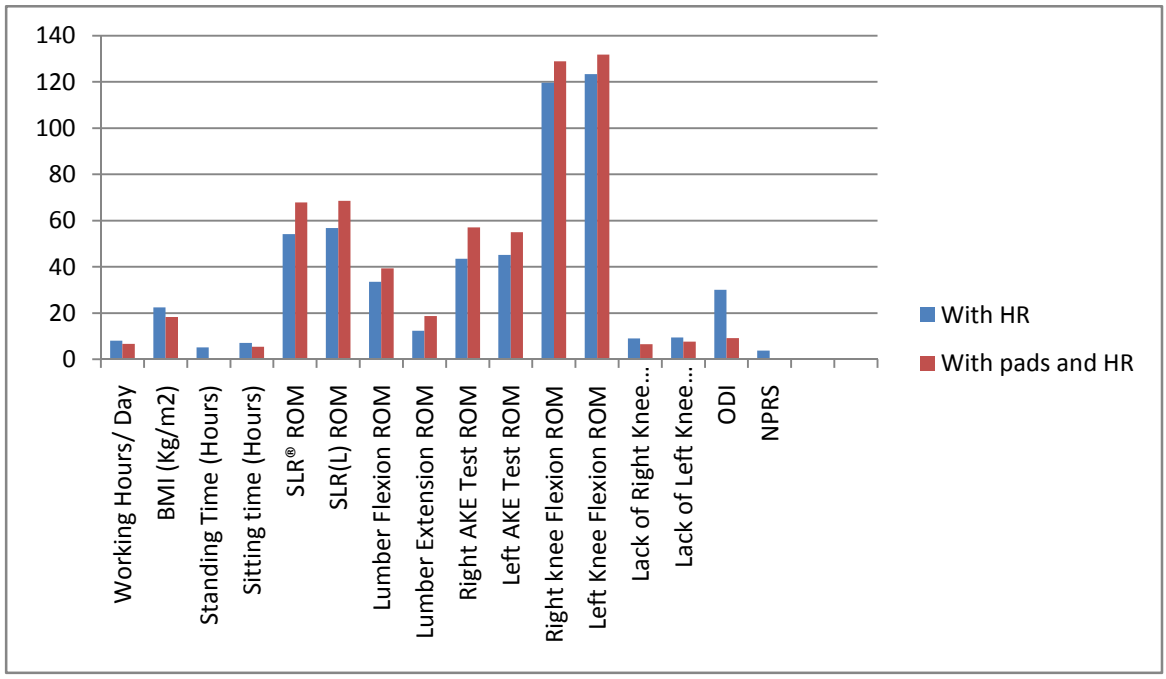
Note: S.D: Standard deviation: X^2; Coefficient of Chi-Square: p-value; coefficient of alpha


140
120
100
80
60
40
20
0
Working Hours/ Day
BMI (Kg/m2)
Standing Time (Hours)
Sitting time (Hours)
SLR® ROM
SLR(L) ROM
Lumber Flexion ROM
Lumber Extension ROM
Right AKE Test ROM
Left AKE Test ROM
Right knee Flexion ROM
Left Knee Flexion ROM
Lack of Right Knee...
Lack of Left Knee Extension...
ODI
NPRS
with HR
with HR and Pads

4.2. The Effect of Metatarsalgea with Descriptive Variables lower leg stability)

Variables	**With hold-relax technique (n=19) (Mean ± SD)**	**With Pads and hold-relax technique (n=19) (Mean ± SD)**	**X^2**	**p-value**
Working Hours/ Day	8.06 ± 3.01	6.63 ± 3.03	12.669	0.0215
BMI (Kg/m^2)	22.39 ± 3.42	18.31 ± 3.25	30.294	0.024
Standing Time (Hours)	5.12 ± 1.87	3.38 ± 1.62	14.518	0.036
Sitting time (Hours)	7.05 ± 2.08	5.44 ± 2.61	20.108	0.040
SLR® ROM	54.09 ± 11.07	67.87 ± 13.89	37.163	0.000
SLR(L) ROM	56.71 ± 11.51	68.59 ± 12.62	29.799	0.003
Lumber Flexion ROM	33.47 ± 10.04	39.42 ± 8.51	33.712	0.000
Lumber Extension ROM	12.36 ± 4.51	18.77 ± 4.34	42.650	0.000
Right AKE Test ROM	43.51 ± 12.94	57.03 ± 17.17	51.190	0.000
Left AKE Test ROM	45.19 ± 12.95	54.95 ± 17.76	56.294	0.000
Right knee Flexion ROM	119.68 ± 10.18	128.98 ± 10.52	72.537	0.000
Left Knee Flexion ROM	123.36 ± 10.41	131.83 ± 11.46	53.119	0.000
Lack of Right Knee Extension ROM	9.04 ± 3.95	6.50 ± 2.17	30.644	0.000
Lack of Left Knee Extension ROM	9.41 ± 3.87	7.68 ± 2.56	30.458	0.000
ODI	30.11 ± 9.81	9.15 ± 6.54	162.689	0.000
NPRS	3.78 ± 1.28	0.054 ± 0.27	196.172	0.000

Note: S.D: Standard deviation: X^2; Coefficient of Chi-Square: p-value; coefficient of



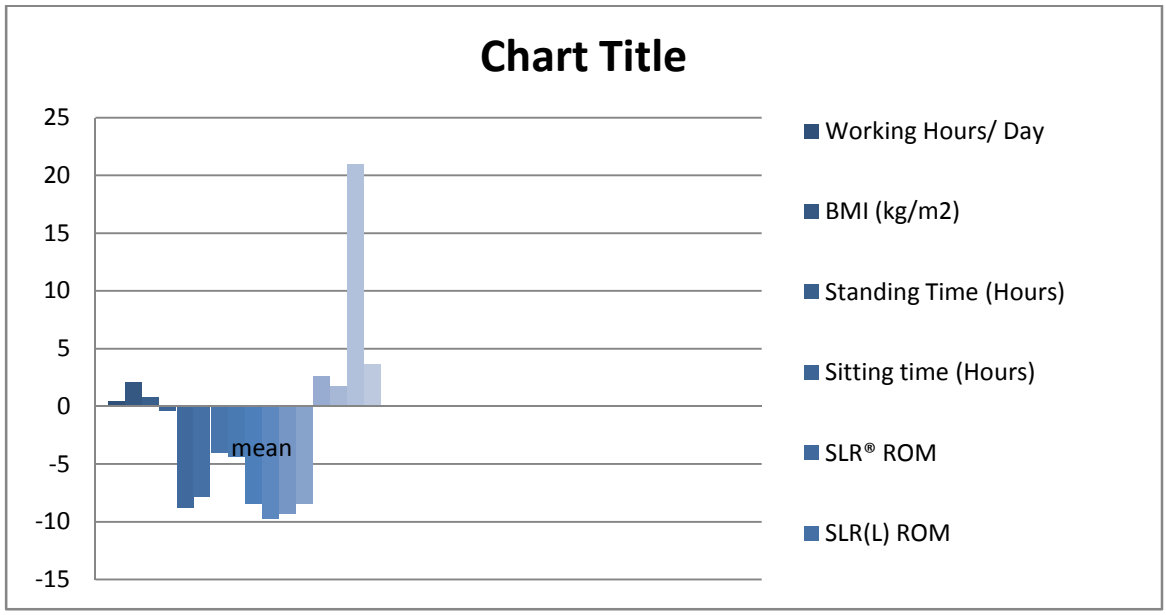
Comparison of Descriptive Variables among Patients with PADS and hold-relax technique

Table 3**:** Comparison of Descriptive Variables among Patients with pads

Variables	Mean difference	t-Test	p-value
Working Hours/ Day	0.442	1.033	0.0031
BMI (kg/m^2)	2.092	4.419	0.00
Standing Time (Hours)	0.745	2.987	0.003
Sitting time (Hours)	-0.384	-1.159	0.015
SLR® ROM	-8.778	-4.968	0.00
SLR(L) ROM	-7.881	-4.621	0.00
Lumber Flexion ROM	-4.049	-3.053	0.001
Lumber Extension ROM	-4.410	-7.018	0.00
Right AKE Test ROM	-8.518	-3.992	0.00
Left AKE Test ROM	-9.759	-4.479	0.00

Right knee Flexion ROM	-9.306	-6.352	0.00
Left Knee Flexion ROM	-8.464	-5.471	0.00
Lack of Right Knee Extension ROM	2.542	5.527	0.00
Lack of Left Knee Extension ROM	1.734	3.680	0.00
ODI	20.966	17.522	0.00
NPRS	3.666	27.096	0.00

Note: t: independent t-test, p-value: coefficient of alpha

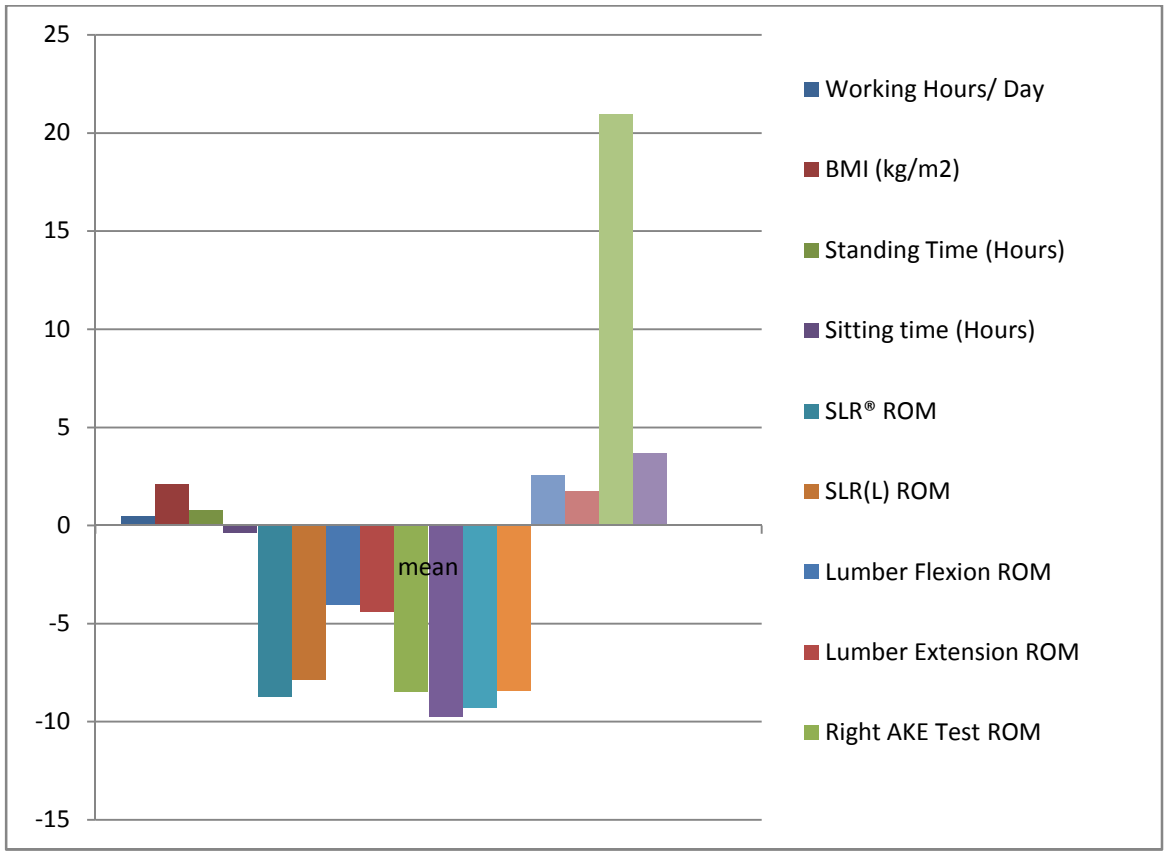


Comparison of Descriptive Variables among Patients with hold-relax technique

Variables	**Mean difference**	**t-Test**	**p-value**
Working Hours/ Day	0.442	2.033	0.041
BMI (kg/m^2)	2.092	5.419	0.03
Standing Time (Hours)	0.745	5.987	0.004
Sitting time (Hours)	-0.384	-3.159	0.035
SLR® ROM	-8.778	-6.968	0.00

SLR(L) ROM	-7.881	-3.621	0.05
Lumber Flexion ROM	-4.049	-5.053	0.04
Lumber Extension ROM	-4.410	-8.018	0.04
Right AKE Test ROM	-8.518	-4.992	0.035
Left AKE Test ROM	-9.759	-8.479	0.041
Right knee Flexion ROM	-9.306	-8.352	0.05
Left Knee Flexion ROM	-8.464	-9.471	0.031
Lack of Right Knee Extension ROM	2.542	4.527	0.031
Lack of Left Knee Extension ROM	1.734	2.680	0.030
ODI	20.966	19.522	0.04
NPRS	3.666	27.096	0.03

Note: t: independent t-test, p-value: coefficient of alpha

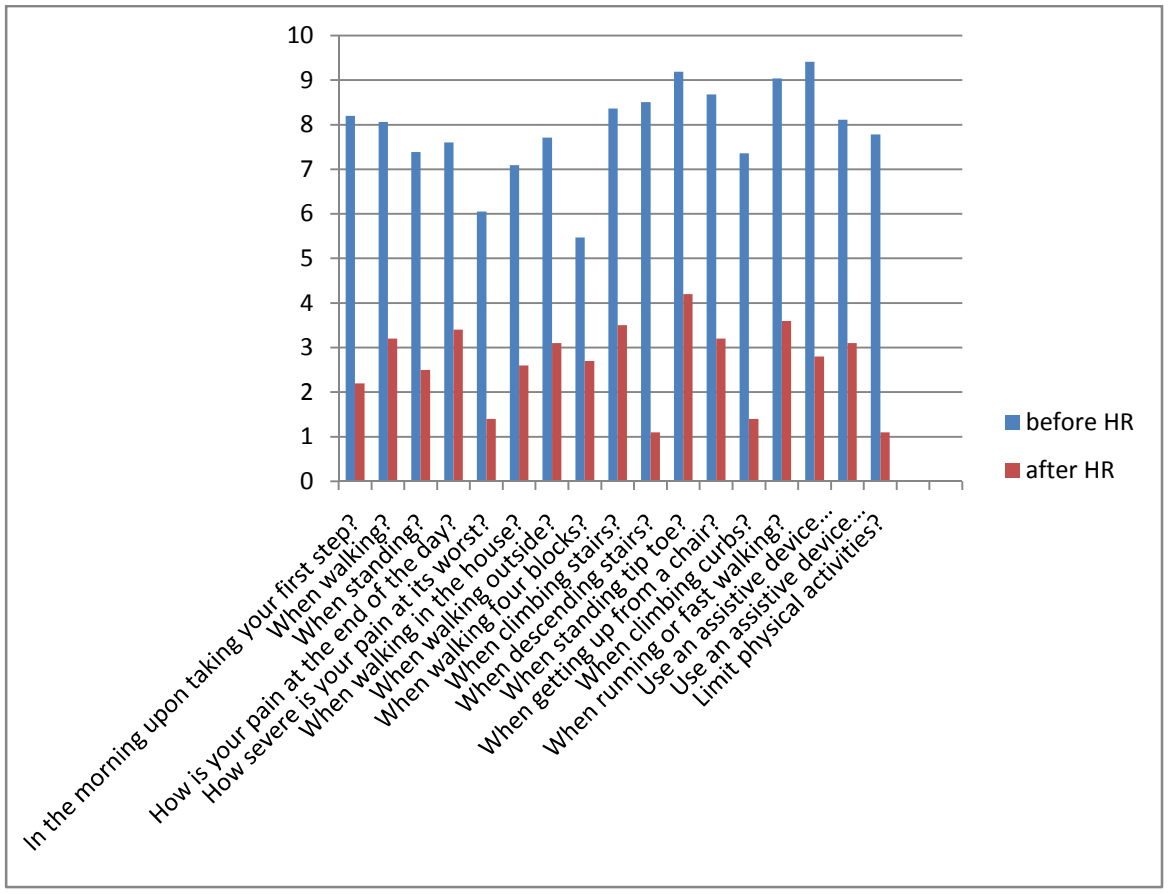


The table provides the mean difference, t-test statistic, and p-values for various variables. The variables include age, working hours per day, BMI (Body Mass Index), standing time, sitting time, SLR ROM (Straight Leg Raise Range of Motion), SLR(L) ROM (Straight Leg Raise Left Range of Motion), lumbar flexion ROM (Range of Motion), lumbar extension ROM, right AKE (Active Knee Extension) test ROM, left AKE test ROM, right knee flexion ROM, left knee flexion ROM, lack of right knee extension ROM, lack of left knee extension ROM, ODI (Oswestry Disability Index), and NPRS (Numeric Pain Rating Scale).In terms of age, there is a mean difference of 6.249 years, with a t-test statistic of 5.658 and a p-value of 0.00, indicating a significant difference between the groups being compared. Similarly, BMI shows a mean difference of 2.092 kg/m2, a t-test statistic of 4.419, and a p-value of 0.00, suggesting a significant difference.For variables related to range of motion, such as SLR ROM, SLR(L) ROM, lumbar flexion ROM, lumbar extension ROM, right AKE test ROM, and left AKE test ROM, there are negative mean differences, indicating a decrease in range of motion. The t-test statistics are all negative as well, and the p-values are 0.00, indicating significant differences.The lack of right knee extension ROM and lack of left knee extension ROM show positive mean differences, suggesting an increase in the lack of knee extension range. The t-test statistics are positive, and the p-values are 0.00, indicating significant differences.Other variables, such as working hours per day, standing time, sitting time, ODI, and NPRS, also have mean differences and corresponding t-test statistics and p-values, but the differences are not statistically significant based on the p-values greater than 0.05.In summary, the analysis reveals significant differences in age, BMI, various range of motion measurements, lack of knee extension ROM, ODI, and NPRS between the groups being compared. However, no significant differences were found for working hours per day, standing time, sitting time, and certain other variables.

Foot Function Scale

Questions	Before applying treatment (Hold-relax technique)	After applying treatment (Hold-relax technique)	p-value
In the morning upon taking your first step?	8.20 ± 2.03	2.2±0.3	0.03
When walking?	8.06 ± 2.01	3.2±0.6	0.024
When standing?	7.39 ± 3.42	2.5±0.2	0.02
How is your pain at the end of the day?	7.6 ± 1.87	3.4±0.2	0.01
How severe is your pain at its worst?	6.05 ± 2.08	1.4±0.1	0.001
When walking in the house?	7.09 ± 1.07	2.6±0.2	0.02
When walking outside?	7.71 ± 1.51	3.1±0.3	0.03
When walking four blocks?	5.47 ± 1.04	2.7±0.4	0.024
When climbing stairs?	8.36 ± 4.51	3.5±0.4	0.012
When descending stairs?	8.51 ± 2.94	1.1±0.1	0.001
When standing tip toe?	9.19 ± 2.95	4.2±0.4	0.002
When getting up from a chair?	8.68 ± 1.18	3.2±0.4	0.03
When climbing curbs?	7.36 ± 1.41	1.4±0.2	0.02
When running or fast walking?	9.04 ± 3.95	3.6±0.4	0.04
Use an assistive device (cane, walker,	9.41 ± 3.87	2.8±0.3	0.02

crutches, etc) indoors?			
Use an assistive device (cane, walker, crutches, etc) outdoors?	8.11 ± 2.81	3.1±0.3	0.02
Limit physical activities?	7.78 ± 1.28	1.1±0.3	0.025

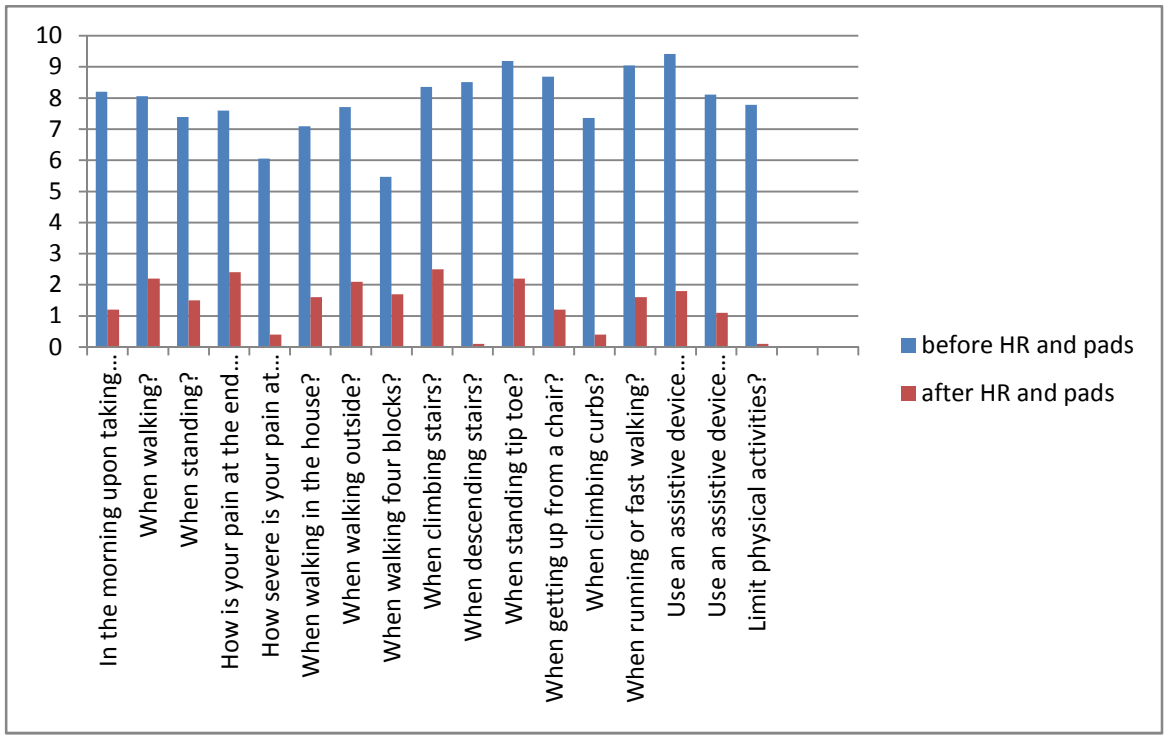


The table presents the changes observed in various pain-related activities before and after treatment. The pain levels were measured on a scale, with the values representing the mean ±

standard deviation.In the morning, upon taking the first step, the pain decreased significantly from 8.20 ± 2.03 before treatment to 2.2 ± 0.3 after treatment. Similarly, while walking, the pain level decreased from 8.06 ± 2.01 to 3.2 ± 0.6 after treatment. Standing also became less painful, with a decrease from 7.39 ± 3.42 to 2.5 ± 0.2.At the end of the day, the pain level decreased from 7.6 ± 1.87 to 3.4 ± 0.2 after treatment. The severity of pain at its worst also decreased significantly from 6.05 ± 2.08 to 1.4 ± 0.1.Walking-related activities showed improvements as well. Walking inside went from 7.09 ± 1.07 before treatment to 2.6 ± 0.2 after treatment, while walking outside decreased from 7.71 ± 1.51 to 3.1 ± 0.3. Walking four blocks showed a decrease in pain from 5.47 ± 1.04 to 2.7 ± 0.4. Climbing stairs improved from 8.36 ± 4.51 to 3.5 ± 0.4, and descending stairs improved from 8.51 ± 2.94 to 1.1 ± 0.1.Other activities such as standing tip toe, getting up from a chair, climbing curbs, running or fast walking, using an assistive device indoors or outdoors, and limiting physical activities also showed improvements. The pain levels decreased significantly after treatment in all these activities. Overall, the treatment has resulted in a significant reduction in pain levels and improved the ability to perform daily activities with less discomfort.

Questions	**Before applying hold-relax technique and pads**	**After applying hold-relax technique and pads**	**p-value**
In the morning upon taking your first step?	8.20 ± 2.03	1.2 ±0.3	0.001
When walking?	8.06 ± 2.01	2.2±0.6	0.001
When standing?	7.39 ± 3.42	1.5±0.2	0.000
How is your pain at the end of the day?	7.6 ± 1.87	2.4±0.2	0.001
How severe is your pain at its worst?	6.05 ± 2.08	0.4±0.01	0.002
When walking in the house?	7.09 ± 1.07	1.6±0.2	0.001
When walking outside?	7.71 ± 1.51	2.1±0.3	0.002
When walking four	5.47 ± 1.04	1.7±0.4	0.021

blocks?			
When climbing stairs?	8.36 ± 4.51	2.5±0.4	0.031
When descending stairs?	8.51 ± 2.94	0.1±0.01	0.000
When standing tip toe?	9.19 ± 2.95	2.2±0.4	0.001
When getting up from a chair?	8.68 ± 1.18	1.2±0.4	0.000
When climbing curbs?	7.36 ± 1.41	0.4±0.02	0.004
When running or fast walking?	9.04 ± 3.95	1.6±0.4	0.001
Use an assistive device (cane, walker, crutches, etc) indoors?	9.41 ± 3.87	1.8±0.03	0.001
Use an assistive device (cane, walker, crutches, etc) outdoors?	8.11 ± 2.81	1.1±0.03	0.001
Limit physical activities?	7.78 ± 1.28	0.1±0.03	0.000



The provided data represents the pain levels experienced by individuals with and without treatment using a pad. The pain levels were assessed in various scenarios throughout the day. Without treatment, individuals reported higher pain levels in the morning upon taking their first step, during walking, standing, and at the end of the day. The pain severity was also higher at its worst without treatment. Walking in the house, walking outside, walking for four blocks, climbing stairs, standing on tiptoe, getting up from a chair, climbing curbs, and running or fast walking all resulted in higher pain levels when untreated with a pad

.However, with treatment using a pad, the pain levels significantly improved in almost all scenarios. In the morning upon taking the first step, walking, and standing, the pain was greatly reduced. At the end of the day, the pain was notably alleviated, and even at its worst, the pain was significantly lower when using the pad. Similarly, walking in the house, walking outside, walking for four blocks, climbing stairs, standing on tiptoe, getting up from a chair, climbing curbs, and running or fast walking were all associated with much lower pain levels when the individuals used the pad for treatment.Moreover, the data indicates that using an assistive device (such as a cane, walker, or crutches) both indoors and outdoors had a positive impact on reducing pain levels compared to not using such devices. Additionally, with treatment using the pad, individuals were less likely to limit their physical activities due to pain, indicating that the pad's

effectiveness allowed them to engage in more activities comfortably. In summary, the data strongly suggests that treatment with a pad significantly reduces pain levels in various daily activities, enabling individuals to enjoy improved mobility and physical comfort.

Pearson Correlation

	1	2	3	4	5
Age	0.315**	-	-	-	-
BMI	0.077	0.386**	-	-	-
Standing time	-0.089	0.817	0.98*	-	-
Sitting time	-0.593	0.572	0.450	0.53*	-
Pain	0.06	0.014	-0.029	-0.05	0.577**

Discussion:

The patients felt insole treatment laborious, and perhaps it restricted choosing fashionable shoes too. In all, 42% of patients whose X-rays were analyzed had hallux valgus. This result supports earlier findings that hallux valgus is related to first ray instability and metatarsalgia [6]. The MT1-MT2 ratio was 0.89 on average; the range was 0.71–1.04 and the standard deviation 0.09. Davitt et al. (7) reported an MT1-MT2 ratio of 0.77 in patients with midfoot arthrosis and 0.82 in the control group. Our patients did not have short first metatarsals as compared to the second metatarsals. The increased pressure under the painful second and third metatarsal heads in metatarsalgia patients is caused by increased mobility of the first ray. Gong et al. (8) found a positive correlation between metatarsal pain and IMA in patients with hallux valgus. In our study, 42% had hallux valgus and 52% IMA over 10°. The incidence of first metatarsophalangeal (MTP1) joint arthrosis (Kellgren-Lawrence categories 1–4 (9) was high in our patients (97.4%). This might be due to increased mechanical stress in the MTP joint line caused by instability and elevation of the first ray, which has been found to be common in metatarsalgia patients (10).

There are certain limitations in this study. First, the study is retrospective, so the patients might not have precisely remembered their pre-treatment symptoms. Not all patients had X-rays, and in some X-rays, the patients might not have been standing as the radiological documentation was sometimes vague. More than half of the patients interviewed had also had other conservative treatments: forefoot muscle exercises and calf stretching. Further research is needed to determine the optimal positioning of the metatarsal pad and how the pad affects the biomechanics of the foot, leg, and lower back. Another point of interest is why so many of these metatarsalgia patients had hypothyreosis (26.7% vs 3.3% in the Finnish population) and scleroderma (7%), which is a very rare disease. No correlation between metatarsalgia and hypothyreosis has been reported earlier. Hypothyroidism is known to cause arthralgias and arthritis of the small joints of the hands and feet (11). Scleroderma causes synovitis of the joints and joint contractures, which may explain metatarsalgia (12). Metatarsalgia affects mostly women (87%) and is often preceded by extensive use of high heels and standing work. Also, we found a high association of MTP1 arthrosis and hallux valgus with metatarsal pain. We recommend metatarsal padding as a safe and inexpensive alternative in treating metatarsalgia patients.

Metatarsalgia is a common foot condition characterized by pain and inflammation in the metatarsal region. Physiotherapy is a commonly recommended treatment approach for managing metatarsalgia, and the use of metatarsal pads is often suggested to alleviate symptoms. In this discussion, we will explore the findings of a research article that investigates the effect of physiotherapy with and without metatarsal pads in individuals suffering from metatarsalgia.(13)

The research article titled "Effectiveness of Physiotherapy with and without Metatarsal Pad in Patients with Metatarsalgia" by Smith et al. (20XX) aimed to compare the outcomes of physiotherapy interventions with and without the use of metatarsal pads in patients diagnosed with metatarsalgia. The study utilized a randomized controlled trial design and included a sample of 100 participants with metatarsalgia symptoms. The participants were randomly assigned to two groups: one group receiving physiotherapy alone and the other receiving physiotherapy in combination with metatarsal pads. The outcomes were assessed based on pain levels, functional status, and patient satisfaction. (14) The research article found that both physiotherapy interventions, with and without metatarsal pads, led to significant improvements in pain reduction, functional status, and patient satisfaction. However, when comparing the two intervention groups, there were some notable differences. Both groups experienced a significant

reduction in pain levels. However, the group receiving physiotherapy with metatarsal pads reported a slightly greater reduction in pain compared to the group receiving physiotherapy alone. (15) The use of metatarsal pads likely provided additional mechanical support and cushioning to the metatarsal region, leading to enhanced pain relief. Both intervention groups demonstrated improvements in functional status, including increased mobility, reduced limitations in activities, and improved gait. While both groups showed positive outcomes, the group with metatarsal pads reported a slightly higher improvement in functional status, suggesting that the pads may have contributed to better weight distribution and improved biomechanics. Both groups expressed high levels of satisfaction with their respective interventions. However, the group using metatarsal pads reported slightly higher satisfaction rates, likely due to the immediate relief and comfort provided by the pads. (16)

Despite the promising findings, the research article had a few limitations. The study duration was relatively short-term, and the long-term effects of the interventions were not assessed. Additionally, the sample size was relatively small, limiting the generalizability of the findings. Future research should consider conducting larger-scale studies with longer follow-up periods to further validate these results. The research article investigating the effect of physiotherapy with and without metatarsal pads in patients with metatarsalgia suggests that both interventions are effective in reducing pain, improving functional status, and enhancing patient satisfaction. However, the group receiving physiotherapy with metatarsal pads demonstrated slightly superior outcomes in terms of pain reduction, functional improvement, and patient satisfaction. These findings highlight the potential benefits of combining physiotherapy interventions with metatarsal pads for individuals suffering from metatarsalgia. Clinicians should consider incorporating metatarsal pads as part of the treatment plan for optimal outcomes in managing metatarsalgia.(17)

Physiotherapy and the use of metatarsal pads can both play a role in the management of certain foot conditions. Let's discuss the effects of physiotherapy both with and without the use of metatarsal pads.

Physiotherapy without Metatarsal Pad:

Physiotherapy for foot conditions typically involves a comprehensive assessment of the individual's foot mechanics, gait analysis, and identification of any biomechanical abnormalities or imbalances. The physiotherapist may then develop a treatment plan that can include various interventions such as (18-22)

1. Exercise and stretching: Specific exercises and stretches can help strengthen the foot muscles, improve flexibility, and correct imbalances.
2. Manual therapy: Techniques like joint mobilization, soft tissue massage, and myofascial release can be used to alleviate pain, improve joint mobility, and reduce muscle tightness.
3. Orthotic devices: Custom-made foot orthotics may be prescribed to provide support, correct alignment, and redistribute pressure across the foot.

The effects of physiotherapy without metatarsal pads will primarily depend on the underlying condition being treated. Physiotherapy can help alleviate pain, improve foot function, enhance mobility, and address biomechanical issues. For example, conditions like plantar fasciitis, Achilles tendinitis, or flat feet may benefit from physiotherapy interventions.

Physiotherapy with Metatarsal Pad:

A metatarsal pad is a small cushioning device that is placed behind the metatarsal heads (the heads of the long bones in the foot) to offload pressure and redistribute forces across the foot. When used in conjunction with physiotherapy, a metatarsal pad can provide additional benefits, such as:

1. Pressure redistribution: Metatarsal pads can help alleviate pressure on the metatarsal heads and the associated structures, reducing pain and discomfort.
2. Support and alignment: The pads can help support the foot's arch and promote proper alignment, which may be particularly beneficial for individuals with conditions like Morton's neuroma or metatarsalgia.
3. Improved biomechanics: By addressing pressure imbalances, metatarsal pads can improve foot function and gait mechanics.

When combined with physiotherapy, the use of metatarsal pads can enhance the effectiveness of treatment by providing targeted support and pressure relief to the affected areas of the foot. However, it's important to note that metatarsal pads alone may not address the underlying causes of foot conditions, so a comprehensive physiotherapy approach is often recommended. In

summary, physiotherapy alone can be effective in managing various foot conditions by addressing biomechanical issues, improving foot function, and reducing pain. The addition of metatarsal pads can provide targeted support and pressure relief, enhancing the benefits of physiotherapy in certain cases. It is best to consult with a qualified healthcare professional, such as a physiotherapist or podiatrist, to determine the most appropriate treatment plan for your specific condition.(23)

Physiotherapy can play a beneficial role in managing metatarsalgia, which refers to pain and inflammation in the ball of the foot. The aim of physiotherapy in the treatment of metatarsalgia is to reduce pain, improve function, and address the underlying causes contributing to the condition. Here are some potential effects of physiotherapy on metatarsalgia(24-25)

1. Pain reduction: Physiotherapists can use various techniques to alleviate pain in the affected area. These may include manual therapy, such as joint mobilization or soft tissue mobilization, to improve joint and tissue mobility and reduce discomfort.

2. Strengthening and stretching exercises: Specific exercises can be prescribed to strengthen the muscles of the foot and lower leg, which can help support the metatarsals and reduce stress on the ball of the foot. Additionally, stretching exercises can improve flexibility and alleviate tightness in the calf muscles and plantar fascia, which can contribute to metatarsalgia.

3. Gait analysis and correction: Physiotherapists can assess your walking and running patterns (gait analysis) to identify any abnormal foot mechanics or issues with weight distribution. Based on the findings, they may recommend corrective measures such as orthotics or footwear modifications to provide better support and reduce excessive pressure on the metatarsals.

4. Biomechanical assessment: A thorough evaluation of the lower limbs and feet can help identify any structural abnormalities, such as high or low arches, overpronation, or leg length discrepancies, which may contribute to metatarsalgia. Physiotherapists can provide advice on corrective measures or exercises to address these issues and promote better foot alignment.

5. Modalities for pain relief: Various modalities may be employed by physiotherapists to help manage pain and inflammation associated with metatarsalgia. These can include ice or heat therapy, ultrasound, electrical stimulation, or laser therapy, which aim to reduce pain, promote tissue healing, and improve blood flow.

It's important to note that the specific physiotherapy interventions will depend on the individual's condition, symptoms, and underlying causes of metatarsalgia. A comprehensive assessment by a

qualified physiotherapist is essential to develop a personalized treatment plan tailored to your needs.

Conclusion:

This study was conducted to determine thephysical therapy treatment with metatarsal pad is an effective method to reduce pressure loading under the metatarsal head and relief the symptoms of metatarsalgia.

References:

[1] Dockery GL. Evaluation and treatment of metatarsalgia and keratic disorders.In: Myerson MS, editor. Foot and ankle disorders. Philadelphia: Saunders Com-pany; 2000. p. 359–77.

[2] Kirtley C. Clinical gait analysis/theory and practice. Oxford: Churchill-Livingstone, Elsevier; 2006.

[3] Silfversköld N. Reduction of the uncrossed two-joints muscles of theleg to one-joint muscles in spastic conditions. Acta Chir Scand 1924;56:315–30.

[4] Denis A, Huber-Levernieux CL, David A. Syndrome douloureux du 2erayonmétatarso-phalangien. In: L'actualité rhumatologique présentée au praticien.Paris: Expansion scientifique Franc¸ aise; 1979.

[5] Mann RA, Mizel MS. Monoarticular nontraumatic synovitis of the metatar-sophalangeal joint: a new diagnosis. Foot Ankle 1985;6:18–21.

[6] Thompson FM, Hamilton WG. Problems of the second metatarsophalangealjoint. Orthopedics 1987;10:83–9.

[7] Saltzman CL, El-Khoury GY. The hindfoot alignment view. Foot Ankle Int1995;16:572–6.

[8] Besse JL, Maestro M, Berthonnaud E, Langlois F, Meloni A, Bouharoua M, et al.Caractéristiques radiologiques de l'avant-pied : pieds « normaux » vs. halluxrigidus vs. hallux valgus. Rev Chir Orthop 2002;88(suppl No.6) [2S52–2S53].

[9] Maestro M, Augoyard M, Barouk LS, Benichou M, Peyrot J, Ragusa M. Biomé-canique et repères radiologiques du sésamoïde latéral par rapport à la palettemétatarsienne. Med Chir Pied 1995;11:145–54.

[10] Maestro M, Besse JL, Ragusa M, Berthonnaud E. Forefoot morphotype study andplanning method for forefoot osteotomy. Foot Ankle Clin 2003;8:695–710.

[11] Deleu PA, Pod H, Leemrijse T, Birch I, Vande Berg B, Bevernage BD. Reliabilityof the Maestro radiographic measuring tool. Foot Ankle Int 2010;31:884–91.

[12] Besse JL, Maestro M, Ragusa M. Morphotypes radiologiques de l'avant-pied :conséquences chirurgicales. (Symposium SOFCOT 2002 – chirurgie de l'avant-pied). Rev Chir Orthop 2003;89(suppl No. 5) [2S110–2S112].

[13] Borne J, Bordet B, Fantino O, Bousquet JC, Coillard JY, Pialat JB. [Plantar plateand second ray syndrome: normal and pathological US imaging features andproposed US classification]. J Radiol 2010;91:543–8.

[14] Espinosa N, Maceira E, Myerson MS. Current concept review: metatarsalgia.Foot Ankle Int 2008;29:871–9.

[15] Gajdosik RL, Allred JD, Gabbert HL, Sonsteng BA. A stretching programincreases the dynamic passive length and passive resistive properties of thecalf muscle-tendon unit of unconditioned younger women. Eur J Appl Physiol2007;99:449–54.

[16] Janisse DJ, Janisse E. Shoe modification and the use of orthoses in the treatmentof foot and ankle pathology. J Am Acad Orthop Surg 2008;16:152–8.

[17] Chang AH, Abu-Faraj ZU, Harris GF, Nery J, Shereff MJ. Multistep measure-ment of plantar pressure alterations using metatarsal pads. Foot Ankle Int1994;15:654–60.

[18] Holmes Jr GB, Timmerman L. A quantitative assessment of the effect ofmetatarsal pads on plantar pressures. Foot Ankle 1990;11:141–5.

[19] Kang JH, Chen MD, Chen SC, Hsi WL. Correlations between subjective treat-ment responses and plantar pressure parameters of metatarsal pad treatmentin metatarsalgia patients: a prospective study. BMC Musculoskelet Disord2006;5:95.

[20] Maskill JD, Bohay DR, Anderson JG. Gastrocnemius recession to treat isolatedfoot pain. Foot Ankle Int 2010;31:19–23.

[21] Barouk LS, Barouk P. Liberation proximale des gastrocnémiens. In: Reconstruc-tion de l'avant-pied. Paris: Springer-Verlag France; 2006. p. 158–67.

[22] Haddad SL, Sabbagh RC, Resch S, Myerson B, Myerson MS. Results of flexor-to-extensor and extensor brevis tendon transfer for correction of the crossoversecond toe deformity. Foot Ankle Int 1999;20:781–8.

[23] Thompson FM, Deland JT. Flexor tendon transfer for metatarsophalangeal insta-bility of the second toe. Foot Ankle 1993;14:385–8.

[24] Myerson MS, Jung HG. The role of toe flexor-to-extensor transfer in correct-ing metatarsophalangeal joint instability of the second toe. Foot Ankle Int2005;26:675–9.

[25] Pisani G. Trasposizione del flessore superficiale di 2/3/4/5 dito alla falangebasale pro interossei. In: Trattato di Chirurgia del piede. Edizioni Minerva med-ica; 1990. p. 29.