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Effect of Closed Chain Exercises on Foot Dysfunction in Postnatal Women

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Keywords
Close Chain Exercises, Foot Dysfunction, Postnatal Women.

Abstract
Background: Close Chain Exercises are the exercises where the distal part of the extremity is fixed to an object, close chain exercises are more functional or it closely approximate to the movement that we mostly use in our daily life. It leads to multiple joint movements. Post pregnancy leads to changes in foot due to increase in weight and causes changes in arches of foot or any foot problems. So in this close chain exercises is given to postpartum women with foot problems.
Objectives: The objective was to check the effectiveness of close chain exercises on foot dysfunction in postnatal women.
Materials and Methodology: An experimental study was carried out using simple random sampling method during 3 months in Krishna hospital. A total of 72 samples were taken for the survey, they were made to fill the foot function index and the one with foot dysfunction were given close chain exercises. A 4 week protocol was set for each women and they were asked to come for follow up after 2 weeks. Each time they were made to fill the foot function index scale to check for improvement in their pain.
Results: Significant, very significant, extremely significant changes were seen for close chain exercises on foot dysfunction in postnatal women.
Conclusion: This study concluded that close chain exercises for postnatal women with foot dysfunction reduced their pain and improved their quality of life.

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1. Introduction

Pregnancy leads to lots of musculoskeletal disorders in women. The women who have their first child, the parous women are more prone to structural changes in their lower limb due to gain in weight post pregnancy[1]. There are many studies related to musculoskeletal pain back pain post pregnancy but lower extremity pain is very common in women post pregnancy and the pain usually starts in third trimester of pregnancy or a month after the delivery[2].

Pregnancy leads to lots of changes in woman's body which include weight gain, joint laxity, postural changes which is mostly leads due to stretched abdominal muscle post pregnancy which cause weakness to abdominal muscles and eventually cause malalignment of the back and poor posture, hormonal level increases during pregnancy which leads to joints and ligaments of the body to loosen.[5] Apart from this one of the less investigated but most commonly reported problem faced by many women is related to foot problem in women post pregnancy.

Feet is a complex structure made for walking, climbing, balancing and much more, they are divided into 3 structures forefoot which consist phalanges the toes, metatarsals are the five long bones that extend from base of each toe, sesamoid bone which is oval shaped below the first metatarsal, midfoot consist of navicular, cuboid and medial intermediate and lateral cuneiforms, they play the major role of weight bearing and stability, and hindfoot consist of calcaneus and talus. There are two joints in the feet they are metatarsophalangeal and interphalangeal. The main muscles present are tibialis posterior and anterior, peroneus longus and brevis, extensors and flexors. Ligaments included in the foot are plantar fascia which is the longest ligament, then calcaneonavicular ligament and calcaneocuboid ligament. The tendon are Achilles tendon, tibialis posterior and anterior tenson. All of these structures work together to carry out two main functions that is weight bearing and propulsion. Common foot problems that can occurs in foot are sprain and strain of ankle, rupture of tenson or ligament , bone fractures, tendinitis(tendon inflammation), osteoarthritis and rheumatoid arthritis.

During pregnancy due to growing womb, baby and enlarged breast contribute to weight gain that puts extra stress on your feet especially the arches so it is common to develop heel pain in women postnatally due to extra weight and stress on the arches[1]. One of the most common complaints we get in post pregnant mothers is foot and ankle pain which mainly occur due to hormonal variation which increases the laxity in the ligaments and cause weakness in the muscles that support the ankle. After giving birth many women notice visible swelling or puffiness especially on their legs, its also called as postpartum swelling[7]. During pregnancy period body absorbs extra water which eventually supports the baby and this extra water is released in the form of sweating and through urination, mostly postpartum sweating occurs when the water weight from pregnancy builds up in the body and remains even after pregnancy and it mainly affects the ankle, legs and feet. The most common foot problems that occur during pregnancy is swelling and oedema which results from extra accumulation of blood[7]. The natural weight gain and enlarging uterus puts pressure on the veins that leads slowing down of circulation and increase fluid retention. This causes pain and discomfort. The additional weight gain that occurs post pregnancy cause stain on the arches of feet that cause them to flatten, and this in turn cause the feet to pronate or roll inward placing strain on your plantar fascia ligament, continuous increase in strain causes small rips and tears leading to inflammation, pain. Other dysfunction of that can occur post pregnancy is Flat Feet in which there are no visible arches in foot when the person stands it causes pain and affects the walking of the person various other dysfunctions like heel pain, muscle cramping pain can also be seen in postnatal women.

During pregnancy there is release of hormones which later expands the uterus and causes pressure on abdominal wall. There is continuous stretching of abdominal muscles which eventually leads to stretching of the muscles and they become weak and the continuous contraction lead to increase in space between the rectus abdominus and caused diasthesis recti. Physiotherapy has played a vital role in this treatment there was previous study which showed that neuromuscular electrical stimulation and kinesiotaping was found effective in increasing strength of abdominal muscles and decreased the space[13]. Postnatal low back pain is also a major issue in many women, another study was done related to use of pilate therapy in this focus is on improving body core and making it more flexible, so pilate

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therapy focused on core muscles of spine which underwent changes during pregnancy and it was found effective.[14]

2. Materials and Methodology:

This study is performed in postnatal women. Total 72 samples were taken for the survey in which postnatal women one month post-delivery were taken. The women were asked whether they are suffering from any kind of foot pain post-pregnancy or even in pregnancy and which didn't subside even after delivery. The amount of pain was checked according to visual analogue scale. Then they were asked to fill the foot function index scale to check the impact of foot pain they were having on their daily life by checking the pain rate, disability scale and activity limitations. According to their amount of pain they were prescribed exercises. The type of study was Experimental based. The Study design was Randomized controlled study. The Place were study was conducted was in karad. The method of sampling was simple random sampling method. The sample size taken was 72 according to the formula $n=z^2 pq /L^2$ in which n is the sample size, z is the standard normal variation at 95% error, p is the population proportion of pregnant women, L is allowable error at 95% that is 5%. The total study duration for this survey is 6 months.

The inclusion criteria for this survey includes postnatal women with foot dysfunction, postnatal women post one month of delivery, the age group of the women should be around 20 to 40 years of age. The exclusion criteria for the survey is antenatal women the one who hasn't delivered yet, age group of women should not be more than 40 years and less than 20 years of age and the women with any kind of postnatal complications. The materials used for this survey are Pen, Paper and visual analogue scale for pain rating, Data collection sheet and a Mat for performing the exercises. The outcome measures used for the survey are two scales foot function index scale and visual analogue scale.

1) Foot Function Index

Foot Function Index is used to measure the impact of foot pathology in terms of pain, disability and activity restriction. It is self-administered index consisting of 23 items divided by 3 subscales on the basis of patients values which include pain which contains questions regarding Pain in the morning upon taking your first step Pain standing barefoot, Pain walking barefoot, Pain standing with shoes, Pain walking with shoes, Pain standing with orthotics, Pain walking with orthotics, how is your pain at the end of the day, how severe is your pain at its worst. Disability scales consist of Difficulty when walking in the house, Difficulty when walking outside, Difficulty when walking four blocks, Difficulty when climbing stairs, Difficulty when descending stairs, Difficulty when getting out of chair, Difficulty when standing tip toe, difficulty when climbing curbs and difficulty while fast waling and running. Activity limitation scale included questions like staying indoor all day due to feet, staying in the bed all day due to feet, using any assistive devices like sticker walker crutches indoors or using assistive devices outdoor and limit physical activity. The patient has to score each question on scale from 0(no pain or difficulty) to 10 (worst pain imaginable or so difficult it requires help). The total ranking for pain scale is out of 90 as it has 9 questions and each question carries 10 points, disability scale also contains scores out of 90 and activity limitation scale includes score out of 50.

2) Visual Analogue Scale (VAS)

It is the scale used for rating the amount of pain a patients feels which mostly ranges across none no pain to extreme amount of pain, it records patient's pain progression or compare pain severity. It is a straight horizontal line of fixed length, usually of 10 cm length in which two end points representing 0 (no pain) and 10 (worst pain).

On Rest:-

0 _____
10

On Activity:-

0 _____
10

3. Intervention: -

Close chain exercises are the exercises where distal extremity is fixed to an object that is stationary, the various exercises included in close chain are squats, deadlifts, lunges, leg presses. All these concentrate

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on co contraction of hamstring, quadriceps, hamstrings, soleus, and gastrocnemius muscle.

According to their score the one with mild pain were given vigorous exercises like deep squats, lunges, leg press and the one with severe pain were given normal exercises like heel slides, mini squats, and ankle toe movements in start and then proceed to vigorous exercises according to their pain intensity. The exercise programme was set for a month in which they were called for follow ups after every 2 weeks. After the study they were again made to fill the foot function index scale to check the improvement in their pain and to check the effect of close chain exercises for foot dysfunction in postnatal women

4. Results:

Table no.1) VAS (On Rest)

VAS (On Rest)	Mean	Standard Deviation	F Statistics	P Value
Pre-test	3.013	0.8306	194.48	<0.001
2nd week	1.819	0.6571	194.48	<0.001
4th week	0.75	0.5503	194.48	<0.001

Table no.2) VAS (On Activity)

VAS (On Activity)	Mean	Standard Deviation	F Statistics	P value
Pre-test	7.0277	0.8218	418.04	<0.001
2nd week	4.0555	0.7485	418.04	<0.001
4th week	3.2083	3.2083	418.04	<0.001

Table no.3) Foot Function Index (Pain Scale)

FFI (Pain Scale) 6	Mean	Standard Deviation	F Statistics	P value
Pre-Test	58.305	3.755	478.95	<0.001
2nd week	47.333	3.431	478.95	<0.001
4th week	36.708	5.169	478.95	<0.001

Table no.4) Foot Function Index (Disability Scale)

FFI (Disability Scale)	Mean	Standard Deviation	F Statistics	P value
Pre-test	70.222	4.715	335.20	<0.001
2nd week	62	5.706	335.20	<0.001
4th week	49	4.357	335.20	<0.001

Table no.5) Foot Function Index (Activity Limitation Scale)

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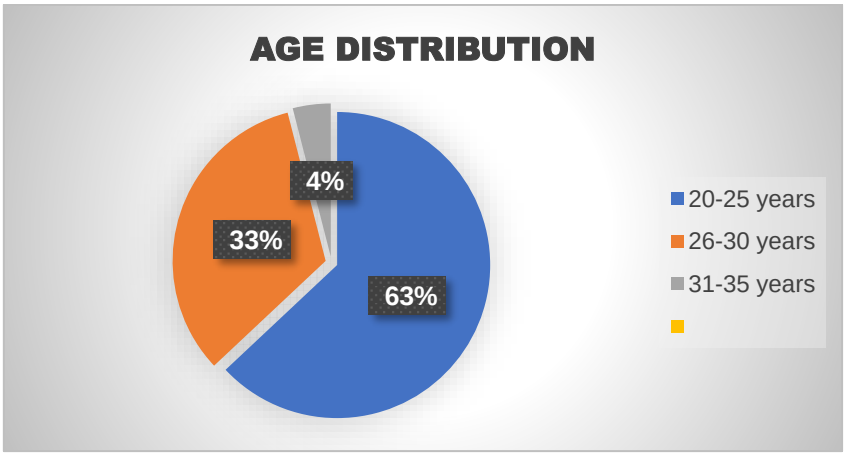
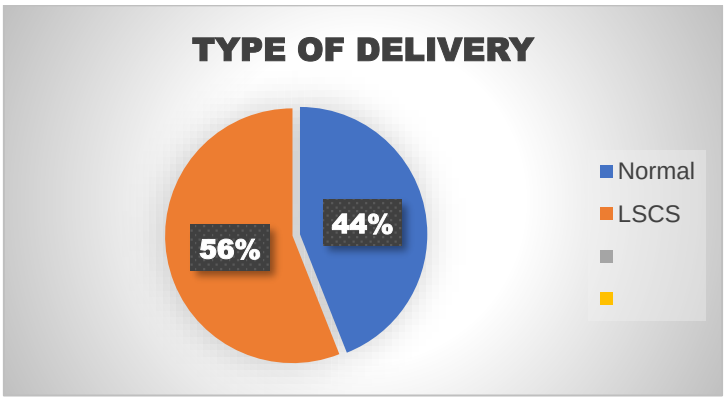
FFI (Activity Limitation)	Mean	Standard Deviation	F Statistics	P value
Pre test	29.93	4.63	241.15	<0.001
2nd week	24.11	4.63	241.15	<0.001
4th week	14.63	3.23	241.15	<0.001



Pie diagram 1- age distribution



Pie diagram 2- Type of delivery

The outcome measure was assessed at the baseline before the treatment and after every treatment during pre-test, on 2nd week and 4th week. The statistical analysis was done by paired t test, one way analysis of variance (ANOVA) method.

Considering the first outcome measure that is Visual Analogue scale (VAS) which is first taken on rest. Table no 1 in which pre-test 2nd week and 4th week is considered very significant according to anova test (p=>0.001) with Mean ± Standard Deviation (3.013±0.8306) for pre-test, (1.819±0.6571) for 2nd week and (0.75±0.5503) for 4th week. In table no 2 visual analogue scale which is then taken on activity so according to ANOVA (p=>0.001) which is very significant with Mean ± standard deviation as (7.0277±0.8218) for pre-test, (4.0555±0.7485) for the 2nd week and (3.2083±3.2083) for the 4th week.

The second outcome measure is the foot function index in which three scales are considered firstly the pain scale then the disability scale and the activity limitation scale. Table no 3 consist of foot function index according to the pain scale is considered in

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which 9 questions are asked in which each question contained maximum 10 score and accordingly total score out of 90 was considered in this (p=<0.001) with mean and standard deviation of 58.305±3.755 in the pre-test, 47.333±3.431 for the 2nd week and 36.708±5.169 for the 4th week.

In table no 4, foot function index according to disability scale is considered in which there were total 9 questions in which each questions were given maximum of 10 score and total score was taken out of 90 in this (p=0.001) and mean and standard deviation of 70.222±4.715 for pre-test, 62±5.706 for 2nd week and 49±4.357 for 4th week

In table no 5, foot function index according to activity limitation was considered in which there were 5 questions were asked and each questions were asked were given total of 10 score and accordingly total 50 scoring was done in which (p=0.001) and mean and standard deviation of 29.93±4.63 for pre-test, (24.11±4.63) for 2nd week and (14.63±3.23 for 4th week was taken.

Considering the demographic table, it was divided into two first is the age group which is from 20-25 years then 26-30 years and 31-35 years. In this total of 45 women were between the age group of 20 to 25 years, then 24 women were between the age group of 26 to 30 years and 3 women were between the age group of 31 to 35 years. So there were total 62.5% of women were in between 20to 25 years of age, 33.3% were in between 26 to 30 years and 4% were between 31 to 35 years. The mean and standard deviation is 25.01±3.033.

The second one was the type of delivery undergone by the women in which 32 women underwent normal delivery and 40 women underwent LSCS so accordingly 44.4% underwent normal delivery and 55.5% underwent LSCS.

5. Discussion:-

The study was undertaken using close kinematic chain exercises for foot dysfunction in postnatal women mostly between one month and 6 months. The purpose of this study is to identify if there is any foot dysfunction present in women post pregnancy and to check whether giving close chain exercises to women is effective or not. There are many foot problems faced by women post pregnancy like changes in arches of foot, flat foot, heel pain, muscle cramps, increase or decrease in arches of foot. There are many studies related to foot dysfunction in women post pregnancy and in pregnancy as well. According to the previous study the foot dysfunctions faced by women in pregnancy period differs according to various trimesters in which there is no significant change in foot structure in women in the first trimester but significant changes in structure of foot was seen in second and third trimester of pregnancy these were because of increase in weight, changes in posture. Hormonal variation seen in women.[5] there were even changes seen in foot in post pregnancy as well. According to one study pregnancy lead to lasting changes in foot like loss of arch height and rigidity as well as arch drop and all these changes in foot lead to musculoskeletal disorders in women which was mainly seen in first pregnancy[1]. The feet of the women changes post pregnancy due to hormonal changes, according to one study the feet of women tends to flatten during the gestational week and it is more pronated and these changes leads to increase in foot length and width[12].

In this study we need to check for any foot problems faced by women in post pregnancy and effect of close chain exercises for them. According to the definition close chain exercises are the exercises where distal aspect of the extremity is fixed to an object or ground while the proximal part is in motion.[4]. According to one study in which close chain exercises were given for correcting hip hyper pronation. Close chain exercise lead to overall strengthening of hip abductors and external rotator muscle which lead to changes in hyper pronation of foot[4].

In our study there was total 72 participants in this survey .Postnatal women post one month of delivery was selected for this survey. In this study particular group of postnatal women who had foot dysfunctions were considered. There were asked the amount of pain they are going through by visual analogue scale and then accordingly they were made to fill the foot function index scale to check the pain scale, disability and activity limitation of the patient and then to give exercises accordingly, according to their score the one with mild pain were given vigorous exercises like deep squats, lunges, leg press and the one with severe pain were given normal exercises like heel slides, mini squats, ankle toe movements in start and then proceed to vigorous

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exercises according to their pain intensity. The exercise programme was set for a month in which they were called for follow ups after every 2 weeks. After the study they were again made to fill the foot function index scale. It is self-administered index consisting of 23 items divided by 3 subscales on the basis of patient's daily activity to check the improvement in their pain and to check the effect of close chain exercises for foot dysfunction in postnatal women[6]. In this significant changes were seen in their pain, after the protocol ended was their visible changes seen in their foot dysfunction, there was decrease in pain in almost all postnatal women.

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