fizjoterapia polska

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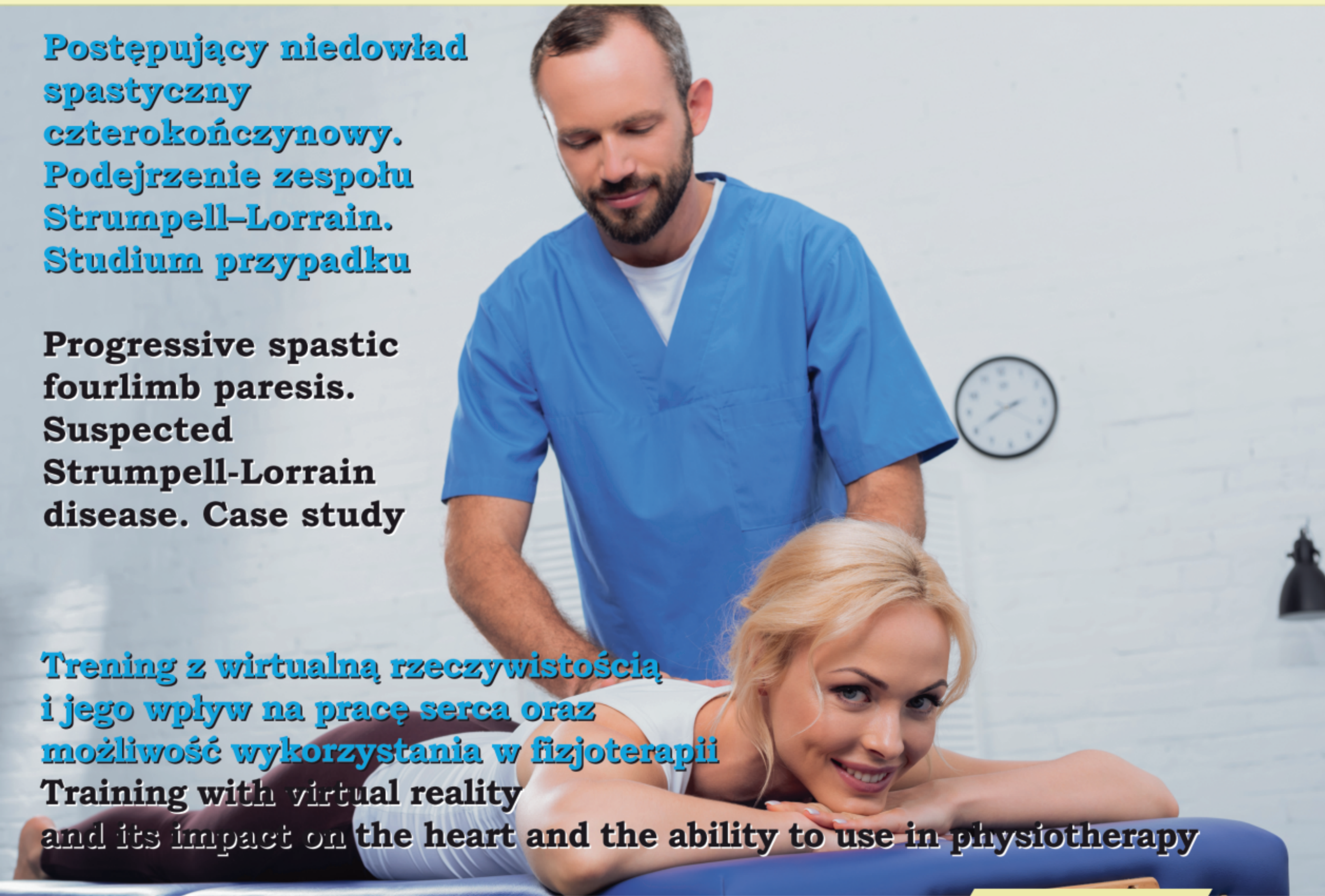

Postępujący niedowład spastyczny czterokończynowy. Podejrzenie zespołu Strumpell–Lorrain. Studium przypadku

Progressive spastic fourlimb paresis. Suspected Strumpell-Lorrain disease. Case study

Trening z wirtualną rzeczywistością i jego wpływ na pracę serca oraz możliwość wykorzystania w fizjoterapii

Training with virtual reality and its impact on the heart and the ability to use in physiotherapy

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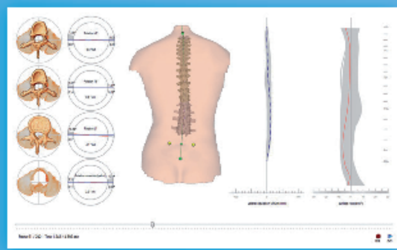
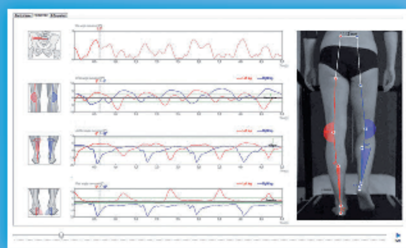
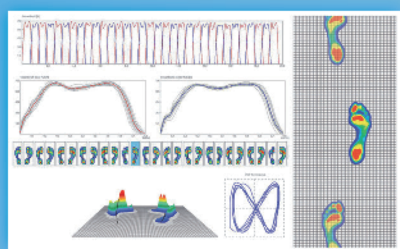


Dynamiczna analiza kręgosłupa



Wideoanaliza chodu



Dynamiczny pomiar nacisku stóp

Możliwości zastosowania klinicznego:

- **Deficyty postawy:**
  Skoliozy, kifozy, lordozy, blokady, skrzywienia miednicy, różnice w długości kończyn dolnych, …
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Zwiększona szerokość i głębokość w obrębie palców i przodostopia
Minimalizuje ucisk i zapobiega urazom

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Zwiększa przyczepność, amortyzuje i odciąża stopy

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Trzy rozmiary szerokości

Podwyższona tęgość

Zwiększona przestrzeń na palce

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• haluksy • wkładki specjalistyczne • palce młotkowate, szponiaste • cukrzyca (stopa cukrzycowa) • reumatoidalne zapalenie stawów • bóle pięty i podeszwy stopy (zapalenie rozcięgna podeszwowego - ostroga piętowa) • płaskostopie (stopa poprzecznie płaska) • bóle pleców • wysokie podbicie • praca stojąca • nerwiak Mortona • obrzęk limfatyczny • opatrunki • ortezy i bandaże • obrzęki • modzele • protezy • odciski • urazy wpływające na ścięgna, mięśnie i kości (np. ścięgno Achillesa) • wrastające paznokcie

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Ważne jest abyśmy mogli dotrzeć do szerszej liczby potrzebujących pacjentów, borykających się na co dzień z trudnymi problemami bólów i dysfunkcji w obrębie kręgosłupa i stawów a któż może to zrobić lepiej od personelu doradczego sklepów medyczno rehabilitacyjnych, hurtowni, poradni, itp. Wydawnictw tematycznych, spotykających codziennie setki osób potrzebujących szybkiej, dostępnej, niedrogiej – skutecznej terapii opartej na naturalnym, nieinwazyjnym przeciwbólowym, przeciw obrzękowym i przeciw zapalnym działaniu naturalnych magnesów! Magnesy nie tylko usuwają ból ale również jego przyczynę czyli destrukcję chrząstki stawowej, w przeciwieństwie do tabletek i maści, które działają tylko powierzchownie nie lecząc prawdziwej przyczyny bólu i niedomagań .

Dlatego też proponujemy Państwu uczciwą współpracę, opartą na wzajemnym zaufaniu, i sprawdzonej renomie naszych atestowanych, sprawdzonych biomagnetycznych produktów; ~ które nigdy nie przyniosły zawodu oczekującym poprawy zdrowia pacjentom ani ujmy stronom współpracującym a wymagający portal sprzedażowy Allegro – z którym współpracujemy ponad 10 lat ~ nagrodził nas tytułem „Super Sprzedawcy" z ogólnodostępną informacją, że 100% klientów poleca nasze produkty bliskim i znajomym! To dla nas wielkie wyróżnienie i odpowiedzialność!

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Przeciwdziałajmy wspólnie tym niedobrym trendom - w przeciwnym wypadku zniknie „made in Poland „z rynku unijnego a chorym, obolałym, zdegustowanym pacjentem zaopiekuje się troskliwa „Bigfarma" ...

Podaję adres naszego e'sklepu; www.butterfly-mag.com

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Z poważaniem – wytwórca; Janina Niechwiej tel. 603 299-035

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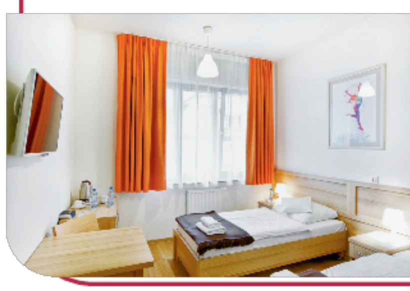

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ZASTOSOWANIE:

TERAPIA POWAŻNYCH KONTUZJI I USZKODZEŃ MIĘŚNI

Głęboka Oscylacja doskonale sprawdza się w leczeniu poważnych kontuzji i uszkodzeń, które są efektem naciągnięcia mięśni i ścięgien.
Głęboka oscylacja z powodzeniem jest stosowana także po treningu: bardzo szybko relaksuje mięśnie, redukuje ból i skutecznie chroni przed mikro-urazami. Stymuluje komórki, dzięki czemu produkty przemiany materii zostają szybciej wydalone przez organizm. Wszystko to sprawia, że organizm znacznie szybciej się regeneruje i pacjent w krótszym czasie wraca do pełnej sprawności.

REDUKCJA OBRZĘKÓW

Głęboka Oscylacja stymuluje przepływ limfy, dzięki temu zbędne produkty przemiany materii jak i płyny zalegające w obrzękach zostają przetransportowane i wydalone. Dlatego w przypadku stosowania DEEP OSCILLATION® obrzęki wchłaniają się znacznie szybciej niż ma to miejsce w przypadku stosowania tradycyjnych zabiegów.

REGENERACJA POWYSIŁKOWA

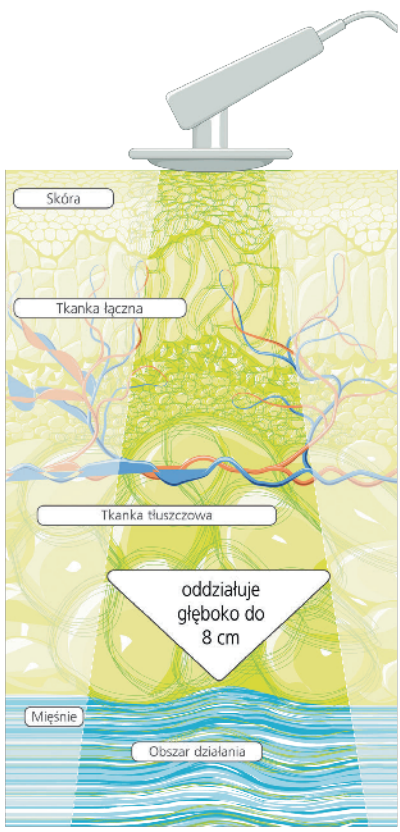
Badania naukowe potwierdziły, że Głęboka Oscylacja ma istotny wpływ na zdolność podejmowania powtarzalnych wysiłków siłowych. Zastosowanie głębokiej oscylacji zwiększa wytrzymałość siłową, obniża powysiłkowy ból mięśniowy oraz napięcie mięśniowe a także wypłukuje z krwi biochemiczne markery zmęczenia mięśniowego. Najkorzystniejsze efekty uzyskuje się stosując Głęboką Oscylację natychmiast po zmęczeniu.

PRZYSPIESZANIE PROCESU GOJENIA SIĘ RAN

Poprzez redukcję obrzęków, procesy stymulujące układ immunologiczny oraz poprawę metabolizmu Głęboka Oscylacja skraca okres gojenia się ran. Leczenie z wykorzystaniem Głębokiej Oscylacji może być stosowane we wczesnej fazie terapii, już w pierwszej dobie po zabiegu chirurgicznym.

WZMACNIANIE ORGANIZMU

Głęboka oscylacja stymuluje miejscowy układ odpornościowy. Badania kliniczne potwierdziły, że terapia z wykorzystaniem Głębokiej Oscylacji zapobiega również powstawaniu infekcji.



ZASADA DZIAŁANIA:

Działanie Głębokiej Oscylacji opiera się na przerywanym polu elektrostatycznym, wytwarzanym za pomocą aparatu DEEP OSCILLATION® pomiędzy aplikatorem, a tkankami pacjenta.

W trakcie zabiegu tkanki pacjenta, dzięki siłom elektrostatycznym są pociągane a następnie zwalniane w wybranym zakresie częstotliwości (5-250 Hz).

W przeciwieństwie do innych rodzajów terapii, Głęboka Oscylacja oddziałuje głęboko nawet do 8 cm na wszystkie warstwy tkanek (skóra, tkanka łączna, tkanka tłuszczowa podskórna, mięśnie, naczynia krwionośne i limfatyczne).

Działanie Głębokiej Oscylacji zostało potwierdzone klinicznie:

- szybki efekt przeciwbólowy
- działanie przeciwzapalne
- szybkie wchłanianie obrzęków
- wspomaganie gojenia ran
- efekt przeciwzwłóknieniowy
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- przyspieszanie procesów regeneracyjnych

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Mechanical Response of Hip and Knee Muscles Following Randomized Crossover Trials in Patellofemoral Pain Syndrome

Mechaniczna reakcja mięśni bioder i kolan po randomizowanych próbach krzyżowych w zespole bólu rzepkowo-udowego

Hamada A. Hamada[1(A,B,C,D,E,F)], Hossam E. Fawaz[1(A,B,C,D,E,F)], Ghada Koura[2(A,B,C)], Noran A. Elbehary[3(A,B,C,D,E)], Salam M. Elhafez[1(A,B,C,D,E)]

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[2]Department of Physical Therapy for Musculoskeletal Disorders and Its Surgery, Faculty of Physical Therapy, Cairo University, Egypt.
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Abstract

Background. Faulty hip kinematics during weight bearing activities is proposed to contribute to patellofemoral pain syndrome (PFPS). However, limited information exists to determine the effectiveness of exercises programs that not only act on the knee joint, but also on the hip joint in patients with PFPS. Purpose. The purpose of this study was to compare between the effect of the starting with hip strengthening exercises before knee exercises program and the starting with knee exercises program before hip strengthening exercises on pain intensity, Kujala questionnaire scale, quadriceps angle (Q-angle), anteversion angle, and eccentric peak torques (PT) for hip abductors, external rotators, and knee extensors in patients with PFPS. Materials and Methods. Twenty-four patients suffering from PFPS were randomly assigned into two equal groups of twelve. Group (A): their mean age, weight, height and BMI values were 23.33 ± 5.39 years, 71.16 ± 13.05 kg, 164.75 ± 4.5 cm, and 26.21 ± 4.71 kg/m^2 respectively. They received hip abductors and external rotators strengthening exercises for three weeks followed by knee extensors strengthening exercises and stretching exercises for hamstring quadriceps, iliotibial band and gastrocnemus for another three weeks. Group (B): their mean age, weight, height and BMI values were 23.16 ± 6.33 years, 69.41 ± 18.14 kg, 164.66 ± 7.27 cm, and 25.2 ± 6.2 kg/m^2 respectively. They received knee extensors strengthening exercises and stretching exercises for hamstring, quadriceps, iliotibial band and gastrocnemus for three weeks followed by hip abductors and external rotators strengthening exercises for another three weeks. Both groups received three to four sessions per week for six weeks. Pain level, Kujala scale, Q-angle, anteversion angle, and isokinetic eccentric PT for hip abductors, external rotators, and knee extensors were recorded before, after three weeks, and after six weeks of exercises. Results. 2x3 Mixed Design MANOVA revealed that there was a significant reduction in level of perceived pain and improvement of Kujala scale in group (A) compared with group (B) after six weeks of exercise ($p < 0.05$). However, there was no significant difference in the Q-angle, anteversion angle, and isokinetic eccentric PT for hip abductors, external rotators, and knee extensors between the tested groups after six weeks of exercise ($p > 0.05$). Conclusion. Starting rehabilitation program with hip strengthening exercises before knee exercises program is more effective than starting with knee exercises program before hip strengthening exercises in reducing pain and improving knee function in patients with PFPS. Consequently, this may help physiotherapists in designing the most effective and efficient prevention and rehabilitation programs for patients suffering from PFPS.

Key words:

Patellofemoral Pain Syndrome, Hip, Knee, Strengthening Exercises, Q -Angle, Anteversion Angle

Streszczenie

Informacje ogólne. Sugeruje się, że wadliwa kinematyka stawu biodrowego podczas ćwiczeń obciążeniowych przyczynia się do zespołu bólu rzepkowo-udowego (PFPS). Jednakże dostępna jest ograniczona ilość informacji umożliwiających określenie skuteczności programów ćwiczeń, które działają nie tylko na staw kolanowy, ale także na staw biodrowy u pacjentów z PFPS. Cel. Celem niniejszego badania jest porównanie wpływu realizacji programu ćwiczeń wzmacniających biodra przed programem ćwiczeń wzmacniających kolana a realizacją programu ćwiczeń wzmacniających kolana przed programem ćwiczeń wzmacniających biodra na intensywność bólu, skalę kwestionariusza Kujala, kąt mięśnia czworogłowego (kąt Q), kąt przodopochylenia i nietypowe maksymalne momenty obrotowe (PT) odwodzicieli bioder, zewnętrznych rotatorów i prostowników kolan u pacjentów z PFPS. Materiały i metody. Dwudziestu czterech pacjentów cierpiących na PFPS zostało losowo przydzielonych do dwóch równych grup po 12 osób. Grupa (A): ich średni wiek, waga, wzrost i wartości BMI wyniosły odpowiednio 23,33 ± 5,39 lat, 71,16 ± 13,05 kg, 164,75 ± 4,5 cm i 26,21 ± 4,71 kg/m^2. Przez trzy tygodnie uczestnicy badania wykonywali ćwiczenia wzmacniające biodra i rotatory zewnętrzne, a następnie ćwiczenia wzmacniające prostowniki kolan i ćwiczenia rozciągające mięsień czworogłowy uda, pasmo biodrowo-piszczelowe i mięsień brzuchaty przez kolejne trzy tygodnie. Grupa (B): ich średni wiek, waga, wzrost i wartości BMI wyniosły odpowiednio 23,16±6,33 lat, 69,41 ± 18,14 kg, 164,66 ± 7,27 cm i 25,2±6,2 kg/m^2. Przez trzy tygodnie wykonywali ćwiczenia wzmacniające prostowniki kolan i ćwiczenia rozciągające ścięgno udowe, mięsień czworogłowy, pasmo biodrowo-piszczelowe i mięsień brzuchaty, a następnie przez kolejne trzy tygodnie ćwiczenia wzmacniające odwodziciele biodra i rotatory zewnętrzne. Obie grupy realizowały trzy do czterech sesji tygodniowo przez sześć tygodni. Poziom bólu, skala Kujala, kąt Q, kąt przodopochylenia i izokinetyczny nietypowy moment obrotowy dla odwodzicieli bioder, rotatorów zewnętrznych i prostowników kolan rejestrowano przed, po trzech tygodniach i po sześciu tygodniach ćwiczeń. Wyniki. 2x3 Mixed Design MANOVA ujawnił, że po sześciu tygodniach ćwiczeń ($p <0,05$) nastąpiło znaczne zmniejszenie poziomu odczuwanego bólu i poprawa na skali Kujali w grupie (A) w porównaniu z grupą (B). Jednak nie było znaczącej różnicy w zakresie kąta Q, kąta przodopochylenia i izokinetycznego nietypowego momentu obrotowego odwodzicieli bioder, rotatorów zewnętrznych i prostowników kolan między badanymi grupami po sześciu tygodniach ćwiczeń ($p> 0,05$). Wniosek. Rozpoczęcie programu rehabilitacji od ćwiczeń wzmacniających biodra przed realizacją programu ćwiczeń wzmacniających kolana jest skuteczniejsze niż rozpoczęcie programu ćwiczeń wzmacniających kolana przed ćwiczeniami wzmacniającymi biodra w celu zmniejszenia bólu i poprawy funkcji kolana u pacjentów z PFPS. Wiedza ta może pomóc fizjoterapeutom w opracowaniu najbardziej skutecznych i wydajnych programów profilaktyki i rehabilitacji dla pacjentów cierpiących na PFPS.

Słowa kluczowe:

Zespół bólowy rzepkowo-udowy, biodro, kolano, ćwiczenia wzmacniające, kąt Q, kąt przodopochylenia

Introduction

Patellofemoral pain syndrome (PFPS) is a common complaint in athletes and young active individuals owing to the high compressive forces involved in their activities that overload the patellofemoral joint. It is more prevalent in female than in male with reported incidence rates in physically active young adult greater than 25% [1]. In addition, PFPS was known by such terms as anterior knee joint pain, patellofemoral compression syndrome, or patellofemoral dysfunction [2].

Although the etiology of PFPS was not exactly understood, repetitive loading of patellofemoral joint causes damage in retropatellar cartilage and subchondral bone [3]. Strength imbalance in extensor mechanism results in patellofemoral pain by stimulating nociceptive fibers in synovium and retinaculum [4]. Patellofemoral joint reaction forces increased on conditions like running, jumping, squatting, or ascending and descending stairs and impose too much pressure on patellofemoral joint, therefore caused an increase in the pain complaints in those patients with PFPS [3].

One of the most commonly accepted causes of PFPS is patellar maltracking and subsequent imbalance of vastus medialis obliquus (VMO) and vastus lateralis (VL). It was reported that patients with PFPS demonstrated greater lateral patellar displacement and tilt, and greater medial femoral rotation when compared with normal controls [5]. Other potential contributing factors are insufficiency of VMO and reduced the flexibility of the muscles and elasticity of soft tissues around the knee joint. Moreover, some theories for the origin of nontraumatic gradual onset of PFPS are:

1. neuromuscular imbalance of VMO and VL;
2. tightness of the lateral knee retinaculum, hamstrings, iliotibial band, and gastrocnemius;
3. overpronation of the subtalar joint [6].

Patellofemoral pain syndrome is a challenging injury, as it has a multifactorial etiology. Therefore, factors related to the development of PFPS can be divided into local factors, distal factors, and proximal factors. Local factors focused on the contribution of the patellofemoral joint mechanics and the surrounding tissues to PFPS [7]. Distal factors focused on the contribution of the foot and ankle to patellofemoral malalignment and pain [8]. Proximal factors focused on the contribution of the hip, pelvis and trunk to patellofemoral malalignment and pain. Moreover, proximal factors including hip muscles weakness have also been proposed to contribute to patellofemoral malalignment and the development of PFPS [4].

Hip musculatures play an important role in controlling the transverse and frontal planes of motions of the femur and their weakness can contribute to PFPS [9]. Strong evidence was reported for a decrease in hip external rotators, abductors, and extensors strengths and moderate evidence for a decrease in hip flexors and internal rotators strengths, but no evidence for a decrease in hip adductors strengths in patients with PFPS compared with healthy controls [10].

Management of PFPS is varying and controversial. It is generally agreed that PFPS should be managed initially by conservative rather than surgical means. However, no single intervention has been demonstrated to be the most effective [2]. Conservative management is the first choice for treatment of PFPS, which can include; patellar taping, strengthening of knee extensors, flexibility exercises, electrotherapy, biofeedback, fitting of proper foot orthoses, and medications [11].

When treating patients with PFPS who demonstrate lack of control of hip adduction and internal rotation during weight-bearing activities, one goal may be optimizing hip muscle function to control these motions [9]. Rehabilitation programs focusing on knee extensors strengthening exercises and the hip flexors, abductors, and external rotators strengthening exercises were related to successful treatment as defined by at least 15% pain reduction on a pain visual analogue scale [12].

Program of isolated hip abductor and external rotator strengthening was effective in improving pain and health status in females with PFPS compared with a no-exercise control group. Therefore, the incorporation of hip strengthening exercises should be considered when designing a rehabilitation program for females with PFPS [13]. However, to the author's know ledge, there is no previous study compared between the carry over effect of starting the hip abductors and external rotators strengthening exercises before the knee strengthening and stretching exercises versus starting the knee strengthening and stretching exercises before the hip abductors and external rotators strengthening exercises in patients with PFPS. Therefore, in the current study, the researchers decided to investigate the carry over effect of starting the hip abductors and external rotators strengthening exercises before the knee strengthening and stretching exercises versus starting the knee strengthening and stretching exercises before the hip abductors and external rotators strengthening exercises on pain level, Kujala questionnaire scale, Q angle, anteversion angle, and isokinetic eccentric peak torques of hip abductors, external rotators, and knee extensors in patients with PFPS.

Materials and methods

Subjects

Twenty-four patients with PFPS with their age ranged from 18 to 35 years were participated in the current study. At the beginning, a brief orientation session about the nature of the study and the treatment and evaluation procedures was accomplished for all patients. They signed an informed consent to participate voluntarily in this study. Then they randomly assigned into two equal groups by a blinded and an independent research assistant who opened sealed envelopes that contained a computer generated randomization card. Group (A): consisted of twelve patients (10 females and 2 males) with mean ± SD age, weight, and height of 23.33 ± 5.39 years, 71.16 ± 13.05 kg, and 164.75 ± 4.5 cm respectively. They started their rehabilitation program with open kinetic chain (OKC) hip strengthening exercises (hip abductors and external rotators strengthening exercises) for three weeks then all dependent variables were measured. This was followed by OKC knee strengthening exercises (straight leg raisings and terminal knee extension strengthening exercises) and stretching exercises (hamstring, quadriceps, iliotibial band, and gastrocnemius stretching exercises) for another three weeks then measuring all dependent variables again.

Group (B): consisted of twelve patients (7 females and 5 males) with mean ± SD age, weight, and of 23.16 ± 6.33 years, 69.41 ± 18.14 kg, and 164.66 ± 7.27 cm respectively. They started by OKC knee strengthening exercises (straight leg raisings and terminal knee extension strengthening exercises) and stretching exercises (hamstring, quadriceps, iliotibial band, and gastrocnemius stretching exercises) for three weeks then all dependent variables were measured. This was followed by OKC hip strengthening exercises (hip abductors and external rotators strengthening exercises) for another three weeks then measuring all dependent variables again.

All participants were referred from the same orthopedic surgeon who was informed of patient inclusion and exclusion criteria. Patients were included if they had anterior or retropatellar knee pain from at least 2 of the following activities:
1. prolonged sitting;
2. stair climbing;
3. squatting;
4. running;
5. kneeling;
6. hopping/jumping [5].

Insidious onset of symptoms unrelated to a traumatic incident and persistent for at least six weeks. Patients were excluded if they had history of any of the following condition: meniscal or other intra articular pathological conditions; cruciate or collateral ligament involvement, patellar subluxation or dis location, previous surgery in the knee and hip joints, knee and hip joints osteoarthritis, fixed flat foot and a history of any conditions affects muscle strength as diabetes mellitus or rheumatoid arthritis.
Of the initial 36 patients recruited over 10-month period, two were excluded due to fixed flat foot and two refused to participate in the study for work reasons, four participants were evaluated before intervention and took treatment then unable to come for evaluation after treatment due to political reason and four participants were evaluated before intervention but did not receive any treatment immediately after evaluation due to their work reason so we decide to exclude them. Therefore, only twenty-four were included in this study and analyzed in our statistical test. We estimated our sample size depending on the work of Khayambashi et al [13] who assessed twenty-eight participants and demonstrated that program of isolated hip abductor and external rotator strengthening was effective in improving pain and health status in females with PFPS compared with a no-exercise control group.

Study design

The study was designed as a prospective randomized clinical trial and patients were assigned to either group A or group B randomly by a blinded and independent research assistant who open sealed envelopes that contained a computer generated randomization card. Randomization was used to prevent bias.

Outcome measures

Before treatment, after three weeks, and six weeks of intervention, pain level were recorded using a 10-cm visual analogue scale (VAS). The 10-cm VAS ranged from zero as "no pain" to 10 as "the worst pain possible ". The VAS comprised of a 10-cm horizontal or vertical line, a mark on the line was made by the patient to indicate the intensity of pain. The participants were asked to rate their response based on the average pain in the knee joint during the previous week. The procedure is valid, reliable and responsive in assessing the outcome in persons with PFPS [14].
The participants function status was assessed using Kujala questionnaire for patellofemoral joint pain [14]. It is a 13- items knee specific self-report questionnaire, it documents response to s ix activities thought to be associated specifically with anterior knee pain syndrome (walking, running, jumping, stair climbing, squatting, and sitting for prolonged periods with knees bent). In addition, it documents symptoms such as limping, inability to bear weight through the involved limb, swelling, abnormal patellar movement, muscle atrophy, pain, and limitation of knee flexion. The maximum total score of this assessment tool is 100, with higher scores indicating greater levels of knee function and lower levels of pain. This scale shows high test-retest reliability, moderate responsiveness, and adequate validity [14].
The Q angle was measured by the same physical therapist, while the subject was in a weight-bearing position with feet in neutral position and quadriceps relaxes during measurement. The Q angle was measured by placing the goniometer axis at the center of the patella, with the stationary arm aligned to the anterior superior iliac spine and the movable arm aligned to the tibial tuberosity [15]. This method of assessing Q angle, however with the use of universal goniometer, has been reported to have an ICC of 0.89 to 0.98 for intratester reliability [16].
As described by Ruwe et al [17], femoral anteversion angle (FAA) is assessed while the patient lying prone, the examiner stood on the contra lateral side: the left hand was used to palpate the greater trochanter while the right hand internally rotates the hip, with the patient's knee flexed to 90 degrees. At the point of maximum trochanteric prominence, the femoral neck was horizontal. The angle subtended between the tibia and the true vertical, represents the FAA. The FAA was measured with a goniometer. This method with the use of standard goniometer has been reported to have an interclass correlation co-efficient (ICC) of 0.77 to 0.97 for intratester reliability [16].
All patients were assessed before, after three weeks, and after six weeks of exercises for their eccentric peak torques of the hip abductors, external rotators, and knee extensors for both tested groups. They were assessed using an isokinetic dynamometer (Biodex Medical Systems 3). All strength testing was performed with a concentric/eccentric mode of muscle contraction at an angular velocity of 60º/sec for hip abductors and external rotators and at an angular velocity of 90º/sec for knee extensors. Before the isokinetic testing, calibration of the dynamometer was carried out and the participants were provided with detailed instructions for the isokinetic strength testing procedures.

Hip abductors strength test

The positions of the seat and the dynamometer were adjusted for testing of hip abductors; dynamometer orientation 0º, dynamometer tilt 0º, seat orientation 0º, and seatback tilt fully reclined. The attachment of the hip (of the involved side) was attached to the dynamometer (Biodex system 3 pro manual). The participants laid in side lying position on the reclined chair of the apparatus with his back facing the dynamometer, the tested leg was the upward one, and the thigh of the non tested leg and trunk was stabilized by straps. The axis of rotation of the dynamometer was aligned superior and medial to greater trochanter of the tested leg. The seat height and position were adjusted for accurate alignment. The thigh pad was connected to the hip attachment and its length was adjusted to be proximal to the patient's lateral femoral condyle then the thigh pad was secured by its strap. The dynamometer ROM was set from 30º hip abduction (starting position) to 0° (neutral position). After two trial repetitions, the test was conducted. Verbal encouragement was given during the testing procedures to maximize the patient's voluntary effort.

Hip external rotators strength test

The positions of the seat and the dynamometer were adjusted for testing of hip external rotators; dynamometer orientation 0º, dynamometer tilt 0°, seat orientation 90°, and seatback tilt 110º posteriorly. The attachment of the hip (of the involved s ide) was attached to the dynamometer. The participant sat on the chair of the apparatus with the knee joint flexed at 90°. The axis of rotation of the dynamometer was aligned with the longitudinal axis of the femur. The seat height and position were adjusted for accurate alignment. The calf pad was connected to the hip attachment and its height was adjusted to be proximal to the patient's lateral malleolus by approximately five cm then the calf pad was secured by its strap. Shoulder and thigh stabilization straps were fastened. The dynamometer ROM was set from 30º external rotation (starting position) to 0º (neutral position). After two trial repetitions, the test was conducted. Verbal encouragement was given during the testing procedures to maximize the patient's voluntary effort.

Knee extensors strength test

The dynamometer orientation was adjusted according to the standard instructions for knee testing so that the dynamometer head and chair were rotated to 90º. Then the knee attachment was secured on the dynamometer head. Each participant sat on the chair with the back rest inclination was set at 110º posteriorly. Shoulder and waist straps were secured for stabilization and prevention of trunk motion. With the tested knee positioned at 90º flexion, the axis of rotation of the dynamometer was aligned with the axis of rotation of the knee which is located at the posterior aspect of the lateral femoral condyle. A gap of three cm were left between the popliteal fossa and the seat cushion to permit free knee flexion. The calf pad was connected to the knee attachment and its height was adjusted to be placed four cm proximal to the medial malleolus and secured with the padded shin strap. The subject was asked to grasp the dynamometer seat handles with both hands.

The dynamometer ROM was set from full knee extension (starting position) to 90º knee flexion. This ROM was selected to include the ROM where most functional knee activities occur such as sitting, standing, and walking. In addition, patients with anterior knee pain should perform isokinetic eccentric contraction of the knee extensors at an angular velocity 90º/sec. This will avoid high compressive forces on the articular surfaces of the knee joint when using angular velocities below 90º/sec. Therefore, the researchers selected this angular velocity. After two trial repetitions, the test was conducted. Verbal encouragement was given during the testing procedures to maximize the patient's voluntary effort.

Treatment procedures

All patients of the two tested groups received three to four sessions per week, for six weeks. Group (A) received OKC hip strengthening exercises program for three weeks followed by knee exercises program for another three weeks. Group (B) received knee exercises program for three weeks followed by OKC hip strengthening exercises program for another three weeks. Each strengthening exercise for both tested groups was performed for three sets. Each set was consisted of ten repetitions with a rest period of three seconds between the repetitions and a rest period of one minute after completing each set. Each patient was trained at 60% of ten-repetition maximum (the amount of weight that was lifted concentrically and lowered eccentrically through available range of motion exactly ten times). For determination of the ten-repetition maximum, the therapist selected a specific amount of resistance and document how many repetitions can be completed through the full range before the muscle begin to fatigue. A new ten-repetition maximum was reevaluated at the end of each week of strengthening exercises [18].

Regarding OKC hip strengthening exercises program, the exercise program included hip abductors and external rotators strengthening exercises. For hip abductors strengthening exercise, the patient was in side lying position on the uninvolved extremity. The knee of the uninvolved extremity was flexed, while the knee of the involved one was extended. The therapist stood behind the patient and wrapped a sandbag just proximal to the lateral malleolus. While the therapist was stabilizing the pelvis, the patient asked to raise his limb against gravity in abduction, hold for six seconds, then lowering his limb slowly with gravity through another six seconds, and relax [19].

For hip external rotators strengthening exercise, the patient was sitting at the edge of the bed while the hip and knee joints flexed to 90 degrees. The therapist stood beside the patient and wrapped a sandbag just proximal to the lateral malleolus. While the therapist was stabilizing the thigh, the patient asked to rotate his involved leg toward the uninvolved one, hold for six seconds, then return to the starting position slowly through another six seconds, and relax [19].

Regarding knee exercises program, the exercise program included OKC knee extensors strengthening exercises and stretching exercises. The OKC knee extensors strengthening exercises included straight leg raisings exercise and terminal knee extension exercise. Stretching exercises included stretching exercises for quadriceps, hamstring, iliotibial band and gastrocnemius.

The first knee strengthening exercise was straight leg raisings exercise. In this exercise, the patient was in supine lying position with the involved knee in full extension and the uninvolved knee in 90 degrees of flexion. A Sandbag was wrapped just proximal to the lateral malleolus and the patient asked to contract the quadriceps and raise the involved limb against gravity to the level of uninvolved knee, hold for six seconds, then return to the starting position slowly with gravity through another six seconds, and relax [20].

The second knee strengthening exercise was terminal knee extension exercise (short arc knee extension from 15° of knee flexion to full knee extension). In this exercise, the patient was in supine lying position with fully extended knees. A rolled up towel was placed under the involved knee and a sandbag was wrapped just proximal to the lateral malleolus. The patient was asked to raise the involved foot away from the bed by extending the knee as far as possible (still supported by the rolled up towel), hold for six seconds, then return to the starting position slowly with gravity through another six seconds, and relax [20].

For hamstring stretching exercise, the patient was in supine lying position, with full-extended knees. The uninvolved extremity stabilized on the bed by a belt around the anterior aspect of the thigh or by the therapist's hand. The therapist raised the involved extremity while maintaining full knee extension until the stretch felt in the back of the thigh. The stretched position maintained for 30 seconds then relaxed. Hamstring stretching exercise performed for three times repetition with a rest period of ten seconds between the repetitions [18]. For quadriceps stretching exercise, the patient was in side lying position on the uninvolved extremity. The therapist stood behind the patient and grasped the involved flexed knee by one hand, while the other hand stabilized the pelvis. The therapist pulled the involved limb backward until the stretch felt in the anterior aspect of the thigh. The stretched position maintained for 30 seconds then relaxed. Quadriceps stretching exercise performed for three times repetition with a rest period of ten seconds between the repetitions [18].

For iliotibial band stretching exercise, the patient assumed the previous position. The therapist stood behind the patient and stabilized the pelvis by one hand, while the other hand adducts the upper-most involved limb cross the other uninvolved limb until the stretch felt in the lateral aspect of the thigh. The stretched position maintained for 30 seconds then relaxed. Iliotibial band stretching exercise performed for three times repetition with a rest period of ten seconds between the repetitions [18].

For gastrocnemius stretching exercise, the patient was in supine lying position, with full-extended knees. The therapist stood beside the involved limb and cupped the heel by one hand, while the other hand fixed the leg on the bed. The therapist push the foot by his forearm toward the involved leg until the stretch felt in the posterior aspect of the leg. The stretched position maintained for 30 seconds then relaxed. Gastrocnemius stretching exercise performed for three times repetition with a rest period of ten seconds between the repetitions [18].

Statistical analysis

All statistical measures were performed using the Statistical Package for Social Science (SPSS) program version 18 for windows. Prior to final analysis, data were screened for normality assumption, and presence of extreme scores. This exploration was done as a pre -requisite for parametric calculation of the analysis of difference and analysis of relationship measures. To determine similarity between the groups at base line, subject age, height, BMI and body weight were compared using independent t tests.

2x3 Mixed Design MANOVA was conducted to compare PT (Nm) values of the hip abductor s, external rotators, and knee extensors, Q angle, femoral anteversion angle (FAA), pain visual analogue scale (VAS), and anterior knee pain scale (AKPS) at different training periods for group (A) and group (B). In addition, it was conducted to compare between group (A) and group (B) for the tested dependent variables at different training periods. This design involved two independent variables. The first one was the (tested groups); between subject factor which had two levels (Group A and Group B). The second one was the (training periods); within subject factor which had three levels (pre, post three weeks, and post six weeks). In addition, this test involved seven tested dependent variables (eccentric PT of hip abductors, external rotators, and knee extensors, VAS score, AKPS score, Q angle, and FAA). Accordingly, 2×3 Mixed design MANOVA was used to compare the tested variables of interest at different tested groups and training periods. The alpha level was set at 0.05.

Results

There were no statistically significant differences ($P > 0.05$) between subjects in both tested groups concerning age, weight, height, and BMI (Table 1).

Table 1. Descriptive statistics and unpaired t-tests for the mean age, weight, height, and BMI of the patients with patellofemoral pa in syndrome for both groups

	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m²)
Group (A)	23.33 ± 5.39	71.16 ± 13.05	164.75 ± 4.5	26.21 ± 4.71
Group (B)	23.16 ± 6.33	69.41 ± 18.14	164.66 ± 7.27	25.2 ± 6.2
t-value	0.186	0.391	0.034	0.446
p-value	0.854	0.699	0.973	0.660

Statistical analysis revealed that there were significant within subject effect ($F = 12.741$, $p = 0.000$) and tested groups*training periods effect ($F = 3.135$, $p = 0.045$) but there was no significant between subject effect ($F = 0.623$, $p = 0.73$). The descriptive statistics showed increasing in the mean PT values of hip abductors and external rotators, knee extensors, and in AKPS score in both groups at 3 and 6 weeks post tests. Moreover, there were a decreasing in the Q angle, FAA, and level of pain in both groups 3 and 6 weeks post tests (Table 2 and 3).

Table 2. Descriptive statistics for the isokinetic eccentric peak torque (PT) values (Nm) of the hip abductors, external rotators and knee extensors for both tested groups at different training periods.

Isokinetic PT (Nm)	Group A Pre	Group A Post 3 weeks	Group A Post 6 weeks	Group B Pre	Group B Post 3 weeks	Group B Post 6 weeks
Hip abductors PT (Nm)	44.08 ± 13.96	61.16 ± 19.9	63.5 ± 23.99	49.91 ± 18.25	64.25 ± 21.8	76.33 ± 30.33
Hip external rotators PT (Nm)	25 ± 5.18	29.91 ± 4.9	32.58 ± 8.08	31.08 ± 11.88	32 ± 10.19	34.08 ± 9.66
Knee extensors PT (Nm)	39.41 ± 6.9	49.25 ± 18.31	55.25 ± 29.21	42.75 ± 13.32	45.08 ± 9.92	61.16 ± 32.92

Table 3. Descriptive statistics for the Q angle, femoral anteversion angle (FAA), visual analoge scale (VAS) and anterior knee pain scale (AKPS) for both tested groups at different training periods

Dependent variables	Group A Pre	Group A Post 3 weeks	Group A Post 6 weeks	Group B Pre	Group B Post 3 weeks	Group B Post 6 weeks
Q angle	20.64 ± 3.726	15.29 ± 1.68	15.2 ± 1.43	20.11 ± 4.57	18.1 ± 3.98	15.13 ± 2.09
FAA	18.33 ± 5.04	14.5 ± 3	14.4 ± 2.7	19.35 ± 2.96	17.57 ± 2.65	13.97 ± 1.13
VAS	6.5 ± 1.97	3.83 ± 2.03	0.633 ± 0.88	6.87 ± 1.38	3.41 ± 1.72	2.2 ± 1.69
AKPS	69.83 ± 9.85	84.16 ± 7.75	94.75 ± 5.27	68.16 ± 13.8	82.41 ± 10.58	86.41 ± 10.58

Multiple pairwise comparison tests (Post hoc tests) revealed that there were significant increase in the mean values of the hip abductors' PT between (pre versus post 3 weeks and pre versus post 6 weeks) ($p < 0.05$) and insignificant differences between (post 3 weeks versus post 6 weeks) ($p>0.05$) in group (A). In addition, there were significant increase in the mean values of the hip abductors' PT among the training periods (pre versus post 3 weeks, pre versus post 6 weeks and post 3 weeks versus post 6 weeks) ($p < 0.05$) in group (B) (Table 4).
In addition, there were significant increases in the mean values of the hip external rotators' PT between (pre versus post 6 weeks) ($p < 0.05$) and insignificant differences between (pre versus post 3 weeks and post 3 weeks versus post 6 weeks) ($p > 0.05$) at group (A). Also, there were no significant differences in the mean values of the hip external rotators' PT among the training periods ($p > 0.05$) at group (B). Moreover, there were no significant differences in the mean values of the knee extensors' PT among the training periods in both tested groups ($p > 0.05$) (Table 4). Regarding between subject effects, multiple pairwise comparison tests (Post hoc tests) revealed that there were no significant differences in the mean values of the hip abductors' and external rotators' and knee extensors' PT between the two tested groups at all levels of training periods ($p > 0.05$) (Table 4).

Table 4. Multiple pairwise comparison tests (Post hoc tests) for hip abductors, external rotators, and knee extensors peak torques (PT) strength at different training periods for both tested groups

	Group A Hip abductors	Group A Hip external rotators	Group A Knee extensors	Group B Hip abductors	Group B Hip external rotators	Group B Knee extensors
Pre Vs. post 3 weeks	0.013*	0.165	0.12	0.042*	1.00	1.00
Pre Vs. post 6 weeks	0.007*	0.004*	0.178	0.000*	0.475	0.091
Post 3 weeks Vs. post 6 weeks	1.00	0.267	1.00	0.011*	0.530	0.07

Group A Vs. B	Pre Hip abductors	Pre Hip external rotators	Pre Knee extensors	Post 3 weeks Hip abductors	Post 3 weeks Hip external rotators	Post 3 weeks Knee extensors	Post 6 weeks Hip abductors	Post 6 weeks Hip external rotators	Post 6 weeks Knee extensors
P- value	0.389	0.118	0.450	0.722	0.530	0.496	0.263	0.713	0.646

**Significant at alpha level < 0.05*

Multiple pairwise comparison tests (Post hoc tests) revealed that there were significant reduction in the mean values of the Q angle between (pre versus post 3 weeks and pre versus post 6 weeks) ($p < 0.05$) and insignificant differences between (post 3 weeks versus post 6 weeks) ($p > 0.05$) in group (A). In addition, there were significant reduction in the mean values of the Q angle among the training periods ($p < 0.05$) in group (B). Moreover, there were significant reduction in the mean values of the FAA between (pre versus post 3 weeks and pre versus post 6 weeks) ($p < 0.05$) and insignificant differences between (post 3 weeks versus post 6 weeks) ($p > 0.05$) in group (A). In addition, there were significant reduction in the mean values of the FAA between (pre versus post 6 weeks and post 3 weeks versus post 6 weeks) ($p < 0.05$) and insignificant differences between (pre versus post 3 weeks) ($p > 0.05$) in group (B).
Additionally, there were significant reduction in the mean values of the VAS scores among the training periods ($p < 0.05$) in group (A). As well, there were significant reduction in the mean values of the VAS scores between (pre versus post 3 weeks and pre versus post 6 weeks) ($p < 0.05$) and insignificant differences between (post 3 weeks versus post 6 weeks) ($p > 0.05$) in group (B). Furthermore, there were significant increase in the mean values of the AKPS scores among the training periods ($p < 0.05$) in group (A). Also, there were significant increase in the mean values of the AKPS scores between (pre versus post 3 weeks and pre versus post 6 weeks) ($p < 0.05$) and insignificant differences between (post 3 weeks versus post 6 weeks) in group (B) ($p > 0.05$) (Table 5).
Regarding between subject effects multiple pairwise comparisons tests (Post hoc tests) revealed that the mean values of the Q angle and FAA declined significantly in group (A) at post 3 weeks of exercises compared with group (B) ($p < 0.05$). In addition, the mean values of the VAS scores declined significantly in the group (A) at post 6 weeks of exercises compared with group (B) ($p < 0.05$) and the mean values of the AKPS scores improved significantly in the group (A) at post 6 weeks of exercises compared with the group (B) ($p < 0.05$) (Table 5).

Table 5. Multiple pairwise comparison tests (Post hoc tests) for Q angle, femoral anteversion angle (FAA), visual analoge scale (VAS) and anterior knee pain scale (AKPS) at different training periods for both tested groups

	Group A				Group B			
	Q angle	FAA	VAS	AKPS	Q angle	FAA	VAS	AKPS
Pre Vs. post 3 weeks	0.000*	0.000*	0.000*	0.000*	0.015*	0.05	0.000*	0.000*
Pre Vs. post 6 weeks	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Post 3 weeks Vs. post 6	1.00	1.00	0.000*	0.000*	0.000*	0.000*	0.132	0.258

	Pre				Post 3 weeks				Post 6 weeks			
Group A Vs. B	Q angle	FAA	VAS	AKPS	Q angle	FAA	VAS	AKPS	Q angle	FAA	VAS	AKPS
P- value	0.76	0.55	0.59	0.73	0.03*	0.01*	0.59	0.64	0.91	0.61	0.00*	0.02*

**Significant at alpha level < 0.05*

Discussion

The findings of the current study revealed that there was a significant improvement of knee pain and functional status in favor of group (A) compared with group (B) by the end of 6 weeks of the study. In addition, there was a significant reduction of Q angle and anteversion angle in favor of group (A) compared with group (B) by the end of 3 weeks of the study. While, there were no significant differences in isokinetic eccentric peak torques for hip abductors, external rotators, and knee extensors between the two tested groups either by the end of 3 weeks or by the end of 6 weeks of the study.
It was reported that weakness of the hip musculature could lead to increase femoral adduction, medial rotation, anteversion angle, and Q angle during dynamic weight bearing activities, which would increase the lateral patellofemoral joint vector, leading to patellar facet overload [21]. The findings of the present study support the growing body of literatures, which suggest that hip strengthening exercises may be a viable intervention for PFPS. An explanation to this finding is that, proximal lower extremity strength is believed to be vital for control of hip joint position and the resultant alignment of the distal segments [22]. During athletic performance, the hip musculature provides a protective mechanism through its influence on lower extremity alignment. For example, weakness of the illiopsoas and the posterior fibers of the gluteus medius may place the femur in a more medially rotated position, allowing for abnormal movement of the patella within the trochlear groove and increasing susceptibility to PFPS [23].
The findings of this study showed that patients with PFPS who received hip abductors and external rotators strengthening exercises program had significant lower Q angle and anteversion angle compared with patients who received knee exercises program by the end of 3 weeks of the study. These finding were supported by several authors [12, 24, 25] who recommended addition of hip

abductors and lateral rotators strengthening exercises to the rehabilitation program for patients with PFPS. The importance of hip abductors and lateral rotators strengthening in the treatment of PFPS is based on several studies that have demonstrated weakness of the hip abductors and lateral rotators in patients with PFPS [9].

The current study reported a decrease in pain and improvement in knee function in both tested groups. This finding is somehow similar to the findings of a study conducted by Razeghi et al [12] who found that the maximum improvement of pain and functional activities occurs in participants, who received the hip strengthening exercise in addition to traditional exercise program. Also, Khayambashi et al., [13] examined the effectiveness of isolated hip abductors and external rotators strengthening exercises on pain, health status, and hip strength in females with PFPS. Twenty-eight females with PFPS were sequentially assigned to an exercise group (n = 14) or a no-exercise control group (n = 14). The exercise group completed bilateral hip abductors and external rotators strengthening exercises three times per week for eight weeks. Pain (visual analog scale), health status, and hip strength (handheld dynamometer) were assessed at baseline and post intervention. Pain and health status were also evaluated at six months post intervention in the exercise group. The authors revealed that there was significant group by time interactions for each variable of interest. Post hoc testing revealed that pain, health status, and bilateral hip strength improved in the exercise group following the eight-week intervention but did not change in the control group. Improvements in pain and health status were sustained at six-month follow-up in the exercise group. The authors concluded that a program of isolated hip abductor and external rotator strengthening was effective in improving pain and health status in females with PFPS compared with a no-exercise control group. The incorporation of hip strengthening exercises should be considered when designing a rehabilitation program for females with PFPS.

In addition, Dolak et al [26] confirm the results of present study as they reported that the patients who started with hip strengthening reported an earlier and more significant drop in knee pain after only four weeks of rehabilitation, while the patients who initially performed quadriceps strengthening required eight weeks of rehabilitation to achieve a similar decrease in pain. Therefore, both rehabilitation approaches led to improvements in self-reported function, pain, and hip strength, but treatment of PFPS, targeting hip strengthening initially may be more efficient, allowing for muscle training while reducing exacerbation of patellofemoral symptoms.

Additionally, Khayambashi et al [27] evaluated the efficacy of posterolateral hip muscle strengthening versus quadriceps strengthening in reducing pain and improving health status in patients with PFPS. Patients were alternately assigned to a posterolateral hip muscle strengthening group (9 men and 9 women) or a quadriceps strengthening group (9 men and 9 women). The posterolateral hip muscle strengthening group performed hip abductors and external rotators strengthening exercises, whereas the quadriceps strengthening group performed quadriceps strengthening exercises (three times per week for eight weeks). Pain VAS and health status were assessed at baseline, post intervention, and six months follow-up. The authors revealed that there were significant improvements in VAS and health status in both groups from baseline to post intervention and baseline to six months follow-up. Improvements in VAS and health status in the posterolateral hip exercise group were superior to those in the quadriceps exercise group post intervention and at six months follow-up. The authors concluded that although both intervention programs resulted in decreased pain and improved function in persons with PFPS, outcomes in the posterolateral hip exercise group were superior to the quadriceps exercise group. The superior outcomes obtained in the posterolateral hip exercise group were maintained six months post intervention.

Moreover, in the study conducted by Nakagawa et al [24] the results of the pain assessment were obtained using visual analogue scale. They found that the intervention group that received six weeks of hip abductors and external rotators strengthening exercises in addition to quadriceps strengthening exercises showed a significant improvement in pain compared with the control group that received six weeks of quadriceps strengthening exercises alone. The findings of the previous study are also supported by many researchers. Tyler et al [5] findings confirmed those of Mascal et al [28] who said that for more improvement of pain and function activities of patients with PFPS should adding strengthening exercise to hip abductor, lateral rotator muscles to traditional exercise program. Another similar study supported this effect, like of this of Earl & Hoch [29]. On the other hand Fukuda et al [25] found no significant difference in functional activities improvement between the patients received strength exercise for hip muscles in addition to traditional exercise program and patients received traditional exercise program only, however there was significant improvement in pain.

Mascal et al [28] reported pain symptom and function improvement after 14 weeks of treatment associated with increases in the gluteus medius and gluteus maximus isometric muscle force production and improved motor control of hip motion during functional weight-bearing activities. Based on the findings of Mascal et al [28] it is reasonable to suggest that improvements in hip abduction and external rotation strength, which ranged from 32% to 56%, might have resulted in changes in hip kinematics during functional activities. Given that excessive hip adduction and internal rotation have been postulated to adversely affect patellofemoral joint kinematics and kinetics. The changes in hip muscle performance might have resulted in a decrease in patellofemoral joint loading and, therefore, pain. However, care must be taken in attributing changes in patellofemoral symptoms to improved hip kinematics after strengthening in isolation, as it is suggested that changes in hip kinematics may be more related to skill acquisition (skilled practice) as opposed to improvements in hip strength [30].

In the current study, the intervention protocol (starting with hip strengthening exercises before knee exercises program) was more efficient than the intervention protocol (starting with knee exercises program before hip strengthening exercises). As it was able to improve pain symptoms during functional activities within a short period of time and this was the most important clinical finding to the patients. Therefore, the additional time spent on the hip abductors and external rotators strengthening exercises in favor of group (A) by the end of 6 weeks of the study, besides the resultant reduction of Q angle and anteversion angle in favor of group (A) compared with group (B) by the end of 3 weeks of the study was a worthwhile approach in management of PFPS.

Furthermore, after six weeks of exercises, pain symptoms and functional activities improved significantly in group (A) compared with group (B) with statistically increasing in the eccentric hip abductors and external rotators torques in group (A). However, there was no significant difference in the eccentric hip abductors, external rotators, and knee extensors peak torques in group (A) compared with group (B). While the current study did not show pain symptoms and functional improvements to be associated with a statistical significant increase in eccentric hip and knee muscles peak torques, the researcher suggest two possible reasons for this finding. First, statistical significance in hip and knee muscles peak torques may not be attained because of the small sample size of the current study. Second, the better motor control of hip motion during the functional activities in favor of group (A) compared with group (B). One should also consider that a lack of statistically significant difference may not always mean a lack of clinical significance.

There are several limitations of our study. First, small sample size may limited generalization but we recruited 12 patients in each group based on previously published data [13] to detect difference in pain and functional scale with power analysis 80 % and at alpha level of 0.05. Second, we did not assess the long term effect of (starting with hip strengthening exercises before knee exercises program) and (starting with knee exercises program before hip strengthening exercises) on (eccentric peak torques of hip abductors, external rotators, and knee extensors, VAS score, AKPS score, Q angle, and anteversion angle). Third limitation was the absence of control group of patients with PFPS who received no treatment as the author did not want to leave the patients untreated through the long period of the study. Further research should include a greater sample size and a follow up period.

Conclusion

Starting rehabilitation program with hip strengthening exercises before knee exercises program is more effective than starting with knee exercises program before hip strengthening exercises in reducing pain and improving knee function in patients with PFPS. Consequently, this may help physiotherapists in designing the most effective and efficient prevention and rehabilitation programs for patients suffering from PFPS.

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