Effect of Rehabilitation Program on Standing Balance in Patients with Patellofemoral Pain

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ABSTRACT

Physiotherapy is the most common of all physical interventions in the treatment of patellofemoral pain (PFP). Knee proprioceptions are important for balance control. The purpose of this study is to investigate the effect of physical therapy treatment on static postural stability. Twenty-five male patients diagnosed as PFP participated in the study. Postural sway measurements were recorded using the Balance Master System during static condition. There was a statistically significant improvement of static balance in-patient with PFP after physical rehabilitation program. It can be concluded that Physical therapy treatment has valuable role in improving balance in patients with PFP and may produce functional benefits.
Keywords: *Patellofemoral pains, postural sway, balance.*

INTRODUCTION

Patellofemoral pain (PFP) is one of the most common musculoskeletal problems of the knee affecting about 25% of the population[3]. PFP is a condition describing anterior or retropatellar knee pain in the absence of other pathology that is usually attributed with repetitive lower limbs activities[10] and often made worse by stair climbing, prolonged sitting, squatting and kneeling[19]. Quadriceps atrophy secondary to knee pain; result in altering the muscle receptors function and decrease its force production, which accompanied with loss of joint motion sense with rapid muscular imbalance of knee extensors leading to knee joint instability[4]. Joint movement and static joint position senses are originated from sensory receptors located in the joint, muscles, tendons and surrounding skin areas[23]. Static joint position sense is defined as the ability to detect static limb position[14].

Balance is the ability to control the upright posture under variety of conditions[2]. Postural control is essential for activities of daily living; it allows their performance that ranged from maintenance of static positions to complex dynamic activities[7]. Human balance and posture depend on coordinated integration of sensory input from vestibular and visual systems and on somatosensory information from the extremities, trunk, and neck. Dysfunction in any part of the system may result in impaired body balance[22]. A correlation between the improvement in knee joint position sense and return to the functional pre injury level of activity has been demonstrated[11].

Postural control is defined as the maintaining state of balance during any activities[18]. It can be assessed under either static or dynamic conditions. Static tests assess the ability to maintain an upright position in various situations, such as with the eyes closed or with expected or unexpected movements. Dynamic tests assess balance control during voluntary movement, such as walking or rising from a chair[17]. Postural sway was used as one measure of standing balance using Balance Master System (BMS). BMS has been reported to be

reliable and valid in evaluating balance[12].
Postural sway was analyzed by
calculating the medial-lateral displacement of the center of gravity[15]. The ability to balance requires that the body's center of gravity lie over the base of support. Large excursions of the center of pressure are generally assumed to be signs of poor balance.

The objective of the present study is to investigate whether balance as assessed by static postural control can be improved by physical therapy in patients with PFP.

SUBJECTS, MATERIALS AND PROCEDURES

Subjects

Twenty-five male patients with PFP were recruited from physical therapy out-clinic at King Khaled University Hospital, Kingdom of Saudi Arabia. The subjects had a mean age of 31.3 ± 5.5 years, a mean weight of 73.2 ± 6.7 Kg, and a mean height of 171.1 ± 5.9 cm. All patients were aged 40 years or younger to reduce the possibility of osteoarthritic changes in the patellofemoral joint and all are male to avoid potential biomechanical differences between sexes. Subjects were examined and referred by orthopedic surgeon. Patients were included if they had anterior or retropatellar knee pain for the last 3 months and pain reported during any of the following activities: prolonged sitting, ascending or descending stairs, squatting and/kneeling. Subjects were excluded if they had signs or symptoms of other knee injury or pathology, which includes: recent history of knee surgery, ligamentous injury, meniscal lesion, and patellar tendon pathology. Also medical problems that might affect balance such as: dizziness, visual problems, and medications, nervous system diseases should be excluded.

The aim and the procedure were described to each subject before his acceptance to participate in the study.

Materials

Pain perception, muscle strength, and static postural sway were evaluated using visual analog scale (VAS), Manual muscle testing (MMT) and Balance Master System respectively. All measurements were evaluated for all subjects before and after 6 weeks of physical therapy program.

Assessment procedures

Pain perception: A 10 cm long visual analog scale (VAS) had been used to measure the pain intensity. The subjects completed the scale by marking on the VAS at a point where they believed that it represent their pain experienced. The scale ranged from no pain (score= 0) to the worst pain (score= 10).

Muscle strength: Manual muscle testing (MMT) had been used to measure strength of the quadriceps, hamstrings, hip adductors, hip abductors, and hip extensors muscles using the standard techniques. Weakness was determined by comparing the muscle strength of the involved side with the uninvolved side.

Static postural sway: The Balance Master Sytem (Neuro Com. International Inc, Clarckamas, USA, 1992) had been used to measure the static balance stability. The system consists of 2 force plates connected to a computer and a monitor screen that run on version v 3.4 soft ware. The machine provides visual feedback about the position of the subject center of gravity (COG) over the base of support in the form of a cursor displayed on a monitor. . The position of the subject's COG was recorded over a 20 second period and was computed and expressed as a percentage of the subject's theoretical Limits

of Stability (LOS) during static balance. Measurement was made while the subject was standing on the BMS platform with his arms by his sides and his feet positioned in accordance with the manufacture's guidelines and looking forward straight ahead. Before measurements were made, each subject completed two trials, the first to familiarize the subject with the test and the second being used for measurement. Postural sway was recorded over 20 seconds, where the subject was asked to focus on the cursor on the monitor screen (which corresponded to the subject's COG). The subject was maintaining the position of the cursor within a centrally placed target box that represented the subject's theoretical LOS. Measurements start initially with the eyes open and then with the eyes closed. Each subject was subjected to pre assessment at the start of treatment and post assessment after completion of 6 weeks of rehabilitation program.

Treatment Procedure

All subjects were subjected to the same course of physical therapy program three times a week for 6 weeks. The program was briefly consists of:

- Cryotherapy for 15 minutes.
- Patellar mobilization to restore gliding of the patella.
- Stretching for tight musculatures including the ilio-tibial band, hamstrings and calf muscles, this was performed by doing each stretch five times with holding 30 seconds.
- Strengthening exercises for the hip and knee joints. Strengthening exercises were performed through progressive repetitive exercises for the knee extensors and knee flexors and hip abductors, adductors and extensors. Quadriceps strengthening was done first while the subject in supine position with pillow under the knee placing it in 15 to 20° flexion and then subject was asked to fully extend the knees. Second from supine lying position, subject was asked to straight leg lifting. Hamstrings strengthening were done while the subject lying prone on a hard bed, he was asked to lift his legs straight until feet touching his buttocks. Hip adductor and abductor groups were strengthened by putting the subject in side lying position and asking him for straight leg lifting for the adductors. Then he changed sides, doing the same lifting for the abductors. Hip extensors were strengthening while the subject in prone; he was asked to lift one leg at a time with the knee in flexion. Progression was done by increasing the number of repetitions and by applying resistance to the lifting limb.

Data analysis: Data were analyzed on a personal computer ("SPSS"-pc, version 10 statistical software) using means, standard deviations and student-paired t-test. Alpha level at 0.05 was used for significance for all tests.

RESULTS

Pain perception: The comparison of the patient before and after treatment values of pain assessment showed significant reduction in the pain intensity (P is < 0.001) as shown in table 1.

Table (1): Means and Standard deviations of pain assessment before and after rehabilitation program.

Test	Mean	S.D.	P-value
Before	7.833	± 0.794	0.001
After	3.076	± 1.056	

Muscle strength: The comparison of muscles strength assessment before and after treatment measured by MMT showed increased on average one grade (usually 3+/5 to 4+/5) for quadriceps and hamstring muscles. The hip adductors, hip abductors, and hip extensors were also improved on average one grade, usually 3+/5 to 4+/5.

Static postural sway: Table 2 represents the comparison of the patient's initial position of COG with that recorded at the end of the rehabilitation program. The amount of postural sway patients' shows during eyes closed and eyes open were compared before and after treatment. Data revealed non-significant improvement in postural sway before and after treatment for the eyes open test. Analysis of the eyes-closed test shows statistical significant improvement in postural sway before and after treatment.

The results of the study confirm the improvement in standing balance after physical therapy program as shown in figure 1.

Table (2): Means and Standard deviations of static balance measurements before and after rehabilitation program.

Measurement	Eye open		Eye closed	
Rehabilitation	Target sway Mean ±SD	% LOS Mean ±SD	Target sway Mean ±SD	% LOS Mean ±SD
Before	0.84 ± 1.4	40.7 ± 13.5	1.5 ± 2.5	37.4 ± 13.7
After	0.67 ± 0.4	21.2 ± 14.3	0.17 ± 0.02	20.1 ± 13.9
P-value	0.15	0.001	0.001	0.005

LOS = Limit of stability SD = standard deviation

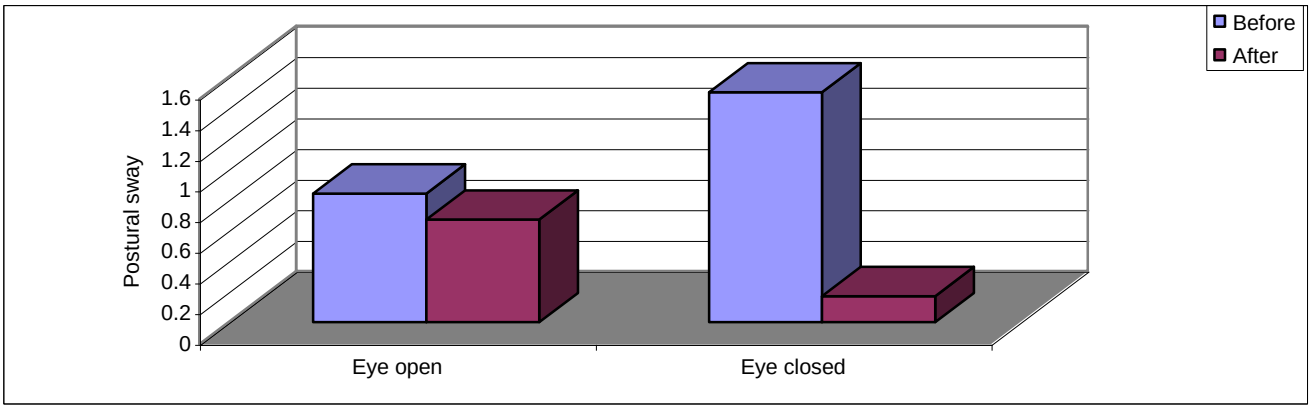

Fig. (1): Postural sway during Eye open and Eye closed before and after treatment.

DISCUSSION

Assessment of balance deficits and their rehabilitation are valuable in physical therapy. Normative data for standard postural sway measurements have shown broad variability among subjects[9]. The knee joint has rich sensory innervations and has mechanoreceptors in the anterior and posterior cruciate ligaments, collateral ligaments and menisci[20]. Patients with knee injury showed poorer joint position sense than those of a similar age. This might be expected as a result of lytic enzymes released around the joint, which may cause damage to the receptors end organs within the joint capsule[13].

The results of the present study show the improvement in body balance after rehabilitation program in patients with PFP. This balance improvement with reduction in postural sway was less evident when the subjects performed the test with their eyes open. This is expected because vision compensates for proprioceptive sensory loss and lack of visual feedback increases body sway in patients with balance disorders[16]. Also when the visual input is eliminated, there will be an increased demand on other systems[6].

Quadriceps strength and muscle performance are clearly important for balance control. It was suggested that there might be a link between knee muscles and standing balance[1]. Proprioception impairment could be also due to a decrease in afferent input from muscle receptors as a result of change in fusimotor activity. The joint mechanoreceptors have been shown to alter gamma motoneuron discharge, which may in turn affect the muscle proprioceptor system[8].

It is reasonable to assume that physical therapy has contributed to the improvement of balance in the study subjects. Physical exercises cause changes in the excitability of the muscle spindle and Golgi tendon organ that may improve the neuromuscular function leading to improvement in Proprioceptions[24]. Balance improvement after treatment program, was also due to the effect of physical therapy and its efficiency in improving motor control[21].

In the present study there was no control group, which limits the possibility to generate the effect of treatment, but subjects, however can be seen as their own control. There is no doubt that postural sway decrease with balance training. But it should be emphasized that injured proprioception which influencing functional limitations, cannot be ruled out, as only a static balance test was performed. Future controlled study with longer follow up treatment period is important to confirm such results.

Conclusion

In conclusion, the findings of the present study can provide a base to support the benefit in using physical therapy in improving standing balance in patients with Patellofemoral pain.

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الملخص العربي

تأثير برنامج التأهيل على الوقوف المتزن في مرضى الألم الرضفى الفخذي

يعد العلاج الطبيعي من أهم الوسائل المستخدمة لعلاج الألم الرضفى الفخذي. تهدف الدراسة الحالية إلى تقييم تأثير التمرينات العلاجية على الاتزان الثابت لهؤلاء المرضى. أجريت الدراسة على 25 من مرضى الألم الرضفى الفخذي عن طريق قياس التمايل أثناء الوقوف الثابت باستخدام جهاز قياس الاتزان.
أظهرت النتائج تحسن ذو دلالة إحصائية في الاتزان الثابت بعد استخدام برنامج التأهيل، ومن ذلك يتضح أهمية دور العلاج الطبيعي في استعادة الاتزان عند مرضى الألم الرضفى الفخذي.