

Effect of Medial Patellar Tape on Anterior-Posterior Stability in Patello-Femoral Joint Osteoarthritis

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ABSTRACT

Impairment in dynamic balance is associated with frequent falls and poor mobility in the elderly population with patello-femoral joint osteoarthritis (PFJOA). Therefore; treatment is required to enhance their balance, through attempting to correct mechanical mal-alignment, and improving knee joint performance. The aim of this study was to investigate the effect of medial patellar taping technique on anterior-posterior stability index (APSI) and forward reach test (FRT) in patients with PFJOA. Thirty males and females patients with moderate degree of PFJOA, were included in the study, their ages were above 50 years. Patients were randomly assigned into two equal groups: control group (A) which was treated by exercises program; and experimental group (B) which was treated by the same exercises and medial patellar tape. The parallel group randomized controlled trial comprised a three weeks intervention period, where participants in both groups were assessed before treatment (baseline) and after three weeks of treatment (final assessment). Both groups showed an improvement in APSI and FRT with more significant improvement ($p < 0.01$) in experimental group (B). It is suggested that adding medial patellar taping technique to the exercise physical therapy program had more significant improvement on APSI and FRT than exercise alone in patients with PFJOA.

Key words: Patello-femoral joint; Osteoarthritis; Taping; Stability index; Balance; Function.

INTRODUCTION

Osteoarthritis (OA) is a prevalent degenerative disease characterized by the progressive breakdown of articular cartilage, resulting in pain, deformity, and decreased function of affected joints²⁸. OA of the knee is one of the most common causes of disability in the elderly, its prevalence increases with age and there is no known cure².

It is increasingly recognized that OA is a disease of the whole joint and all structures are

affected⁵, Patello-femoral joint (PFJ) degeneration is present in most people with knee OA²⁴ predominantly affecting the lateral compartment¹². PFJ OA is correlated with lateral patellar mal-alignment¹⁵, and this in turn is associated with increased peak patello-femoral contact pressures and loading of the lateral facet¹³ which was strongly related to joint space loss on x-ray and cartilage loss in the respective patellar compartment²¹.

There is a vicious cycle between pain, muscle weakness and physical dysfunction in OA of the knee; all influences the progression of the disease in patients with OA of the knee³, and as knee taping is believed to relieve pain by improving alignment of the PFJ and / or unloading inflamed soft tissues³⁰; The American College of Rheumatology², recommended knee taping for patients with OA, but there is little evidence to justify its use. While the influence of such specific interventions on dynamic stability, and on safe performance of ADL activities, deserves further investigation³².

Quadriceps weakness poses a risk for OA incidence also sensory dysfunction (proprioceptive feedback)²² which both determine pain severity and disability in knee OA²⁴. Furthermore, other work has established that quadriceps inhibition 'break phenomena' is related to lateral patellar mal-tracking and chondral lesions in symptomatic individuals¹⁶.

The data indicate that the conventionally used quadriceps strengthening exercises should be supplemented with muscle-enhancing interventions²³. A mechanical effect of medial patellar tape on the quadriceps lever is possible intervention as the medial glide of the patella brought about by taping²⁷ will change the length tension relationship of the Vastus Medialis Obliquus muscle (VMO), facilitating VMO contraction³⁰ which results in improvement in the efficiency of the extensor mechanism¹⁷.

Quadriceps dysfunction may compromise protective mechanisms leading to excessive joint movement, instability, reduced shock absorption during gait, and joint pain²⁰ with some impairment in postural control which is more prominent in the dynamic conditions¹⁸; Therefore patients with PFJ OA suffer from progressive loss of function in walking, ascending and descending stairs, and other lower extremity tasks¹⁴ where balance is an integral component of these activities in daily life⁸.

Exercises are recommended by the American College of Rheumatology Subcommittee on Osteoarthritis², as a non-pharmacological, non-invasive intervention for knee OA. The reported beneficial effects of exercises are pain reduction and increased function³⁴. Most programs include some form of exercises designed to strengthen the quadriceps which plays an important role in dynamic stability during gait among elderly persons³².

Simple, safe, physical treatment procedures such as taping could be of great value and might be combined with other simple, non-invasive interventions³³, where relief of symptoms might be maintained by concurrent exercises to strengthen the medial part of the quadriceps muscle to permanently realign the patella²⁹.

The purpose of this study was to investigate the effect of medial patellar taping technique on APSI and FRT in patients with PFJ OA.

SUBJECTS AND METHODS

Subjects

Thirty participants aged >50 years were selected from the outpatient clinic in Faculty of Physical Therapy, Cairo University; they were randomly assigned into two equal groups: control group (A) which was treated by exercises program; and experimental group (B) which was treated by the same exercises and medial patellar tape.

All patients had moderate degree of PFJOA, as revealed by radiography (grades 2–3 according to the Kellgren and Lawrence²⁵ method of grading), and reported moderate levels of pain and disability (Average pain

severity >4 on VAS). All patients had lateral patellar mal-tracking, more women than men were enrolled. Our inclusion criteria in this study were similar to those used in previous researches on knee OA^{4,8,10,19}.

This study was approved by the ethical committee in faculty of physical therapy, Cairo University. Informed consent was obtained from all participants; all patients were free to withdraw from the study at any time. If any adverse effects had occurred, the experiment would have been stopped. However, there were a minor adverse reaction such as minimal skin irritation under tape which doesn't stop the treatment; and so the data of all the participants were available for analysis.

Evaluated parameters

Functional reach test

Forward functional Reach test (FRT) was used, which is a measure of anterior-posterior dynamic balance; it equals the difference, in inches, between arm's length and maximal forward reach, using a fixed base of support. The test utilizes a 48-inch (122 cm) measuring device or "yardstick" for measuring forward reach fig. 1, A reach of less than or equal to 6 inches (16 cm) predicted poor balance¹¹. The test was repeated 3 times and average score was calculated.



Fig. (1): Forward reach test.

Anterior-posterior stability index (APSI)

This index is a measure of dynamic balance, Biodex stability system was used to measure APSI; it utilizes a dynamic multi-axial platform, which can be set at variable degrees of instability. The test duration was set

for 30 sec. through levels (8-4) (where 8 is the most stable level). The patient was instructed to try to achieve a centered position on the platform by keeping the cursor centered on the visual feedback screen directly in front of the patient. Patients were tested with eye open, without hand support with their arms across their chests, both feet striding without foot wear Fig. 2. Each patient had at least a 5-minute practice period to become familiar with the balance device. All patients completed three consecutive balance trials on the platform; the scores were averaged from the three trials.



Fig. (2): The patient during the testing procedure on Biodex system.

Treatment procedures

Exercises program

Both groups (A and B) received the same exercises program Table 1; three times a week for three weeks. In group (B), all exercises were done after tape application.

Table (1): Exercises program.

Exercise	Hold time	Repetitions
-Buttock squeeze	5 sec.	5 (both legs)
-Straight leg raising	5 sec.	5 (each leg)
-Terminal knee extension	5 sec.	5 (each leg)
-Leg press exercise	-	5 (both legs)
-Half squats	-	5 (both legs)
-Hamstring stretch	15-20 sec.	5 (each leg)
-Iliotibial band stretch	15-20 sec.	5 (each leg)
-Standing balance	-	5 (each direction)

Taping procedure

The tape was applied for three weeks and reapplied every 48 hours during the treatment session before exercises practice. Skin was shaved before application. The length of tape was calculated at 50% of the total circumference of the patient's knee, this is in order to account for anthropometric differences between patients⁷.

Therapeutic 4 cm rigid tape (Jaybird 978, zinc oxide tape, USA) provided medial glide and medial tilt of the patella fig. 3. Hypoallergenic under-tape (medica micro pore) was applied beneath the rigid tape to prevent irritation of the skin, silk tape (alpha plast s) was applied over to add more tape fixation for the next 48 hours.



(A)Medial glide of the patella with tape direction.



(B)Medial tilt of the patella with tape direction.

Fig. (3): Medial patellar taping.

Statistical Analysis

The mean values of FRT and APSI obtained before and after three weeks in both groups were compared using paired "t" test. An unpaired "t" test was used for comparison between the two groups ($P < 0.05$).

A total of thirty male and female patients participated in this study; they were randomly assigned into two groups, control group (A) and experimental group (B).

The control group consisted of 15 patients (11 female / 4 male) with mean age of 56.47 (± 7.24) and mean BMI of 33.55 (± 2.57),

where the experimental group consisted of 15 patients (12 female / 3 males) with mean age of 57.40 (± 6.36) and mean BMI of 33.62 (± 3.59).

Both groups showed a significant improvement in all measured variables as shown in Table 2 and 3.

But the experimental group (B) showed better improvement than the control group (A) with the P-value < 0.001 as shown in table 4, which indicates more improvement of dynamic balance and function in patients with PFJ OA wearing medial patellar tape.

Table (2): Comparison between the mean values measured pre and post-treatment in control group.

Variable	Mean \pm SD		t value	P-value
	Before	After		
FRT	5.9 \pm 0.82	8.5 \pm 0.27	9.602	0.001
APSI	3.81 \pm 0.87	3.29 \pm 0.92	8.107	0.001

Table (3): Comparison between the mean values measured pre and post-treatment in experimental group.

Variable	Mean \pm SD		t value	P-value
	Before	After		
FRT	7.9 \pm 0.57	10.75 \pm 0.50	14.834	0.001
APSI	4.08 \pm 0.49	2.29 \pm 0.46	10.463	0.001

Table (4): Comparison between the mean values in two studied groups measured pre and post treatment.

Variable	Mean \pm SD		t value	P-value
	Control	Experimental		
FRT	8.5 \pm 0.27	10.75 \pm 0.50	5.911	0.0001
APSI	3.29 \pm 0.92	2.29 \pm 0.46	3.765	0.001

DISCUSSION

Other previous works on medial patellar taping were short period studies, which are not used in clinical practice, although their results were effective and consistent with our study which was applied for relatively long period of treatment.

Crossley et al.,⁹ found that patellar tape resulted in a significant reduction in lateral patellar displacement and lateral patellar tilt in PFJ OA group. These results indicate that patellar tape may be a useful treatment for people with PFJ OA.

Cushnaghan et al.,¹⁰ found that the medial Patellar taping is a simple, safe, cheap way of providing short term effect in patients with PFJ OA.

Contradictory to the results of this study Al-Mutairi and Muhji¹, found that adding knee tape to exercise protocol used in treating knee

OA with PFJ involvement have no positive impact on functional ability of the patients.

The change in the neuromuscular control could be a good explanation for the improvement in dynamic balance, this results agrees with the findings of Chuang et al.,⁸ who demonstrate that knee OA patients could improve their balance function in both static and dynamic conditions after wearing knee sleeves which might prevent knee OA patients from falling down and increase their sense of security during physical activities. These devices provide warmth and even compression that may enhance knee joint proprioception³¹ this might be elicited through an improvement in joint-position sense²⁶. Therefore, may improve knee joint proprioception and then increase static and dynamic function in daily activities.

The application of some form of knee support is thought to augment afferent input

via the enhancement of cutaneous stimulation this could be one way which the tape works to improve the dynamic balance as reported by Hinman et al.,¹⁹ where participants reported a sense of 'support' when wearing therapeutic tape, with improved confidence in the knee which resulted in more steps with the contralateral limb whilst standing on the symptomatic limb.

These results were further confirmed by Callaghan et al.,⁷ who suggested that the loss of afferent information in the group of patellofemoral pain syndrome patients was improved by tape-enhancing feedback information from the muscle spindles, soft tissue and skin.

The muscle power plays a major role in dynamic balance control as stated by Herrington¹⁷. This research supports the argument that in symptomatic individuals the improvements in performance may be brought by an improvement in the efficiency of the functioning of the extensor mechanism. Therefore; tape used in conjunction with exercise interventions may maximize participation, resulting in greater sensorimotor improvements than may be observed with exercise alone or taping alone. Other interventions, such as strengthening exercises, balance activities and functional retraining, are appropriate in reversing sensorimotor deficits²⁰.

These previous findings are further confirmed by this current work as the statistical analysis showed improvement in dynamic balance in the anterior-posterior direction where the quadriceps muscle activation plays the main role in knee stabilization during dynamic tasks.

The results of our current study research using objective assessment methods (biodex stability system) confirmed the results of the previous study of Selfe et al.,³⁵ who noted that neutral taping had a significant effect in improving control of torsional moments. This could help to explain the findings of Hinman et al.,¹⁹ who found an improvement in balance using patellar taping during step down in subjects with OA of the tibio-femoral joint. Even though the tape was applied locally to the PFJ, the effects measured in these studies manifested more globally as an improved

control of the whole knee. This may have important implications for patients with more widespread knee pathology, such as OA of the tibio-femoral joint in addition to PFJ OA.

Selfe et al.,³⁵ studied the significant effect of improved torsional moment which is particularly interesting in the light of the neutral technique applied. This technique did not introduce any medially or laterally directed force to the patella. It is therefore surprising that mechanical changes were measured. This finding lends further support to the idea that patella taping has at least some of its effect through cutaneous sensory stimulation and confirms previous observations that neutral taping of this type can enhance neuro-motor performance⁶.

While taping procedure is being investigated some results; which came to partially disagree with our current findings as the study of Hinman et al.,¹⁹ who stated that knee taping is effective in immediately reducing pain, it does not appear to have a significant immediate impact on observed functional disability associated with knee OA.

These findings suggest that a longer period of tape application may be required before an effect on disability is evident, which was added in the current study (three weeks intervention) as compared with Hinman et al.,¹⁹ work who assessed the effect of tape immediately post-application.

Conclusions

Adding the medial patellar taping technique to the exercise physical therapy program showed more significant improvement in anterior-posterior stability index and forward reach test; which all indicate more improvement of dynamic balance in patients with PFJ OA.

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المخلص العربي

تأثير الرباط اللاصق على الاتزان في مرضى التهاب العظمى المفصلي للركبة

الهدف من هذا البحث هو إيضاح تأثير الرباط الداخلي لعظمة الرضفة على الاتزان في مرضى التهاب العظمى المفصلي للركبة . وقد أجري هذا البحث على ثلاثين مريض تم تقسيمهم عشوائياً إلى مجموعتين متساويتين : المجموعة الأولى : (مجموعة العلاج التقليدي) وتكونت من 15 مريض متوسط أعمارهم 56.47 (± 7.24) سنة ، تم علاجهم باستخدام التمرينات العلاجية . المجموعة الثانية : (مجموعة ربط عظمة الرضفة) وتكونت من 15 مريض متوسط أعمارهم 57.4 (± 6.36) سنة ، تم علاجهم باستخدام الرباط الداخلي للرضفة ثم نفس برنامج التمرينات العلاجية الذي طبق للمجموعة الأولى . تم علاج كل مريض لمدة ثلاث أسابيع متتالية بمعدل ثلاث جلسات أسبوعياً بلجمالي تسع جلسات ، وقد تم تقييم الاتزان الحركي باستخدام اختبار المدى الحركي الأمامي وجهاز قياس الاتزان قبل وبعد انتهاء العلاج . وقد أثبتت النتائج تحسناً ملحوظاً في كلتا المجموعتين بعد العلاج مع وجود فروق إحصائية بين المجموعتين بالنسبة لكل المتغيرات التي تم قياسها قبل وبعد العلاج . وأثبتت النتائج أيضاً أن التأثير المشترك للرباط الداخلي للرضفة إضافة إلى البرنامج التقليدي له أفضلية ملحوظة على البرنامج التقليدي منفرد في تحسين نسبة الاتزان في مرضى التهاب العظمى المفصلي للركبة .