

## Effects of Passive Joint Mobilization on Patients with Knee Osteoarthritis (Kesan Mobilisasi Pasif Sendi ke Atas Pesakit Osteoarthritis Lutut)

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### ABSTRACT

*A controlled, single blinded experimental study was conducted to determine the effects of passive joint mobilization on pain and stairs ascending-descending time in subjects with knee osteoarthritis (OA knee). A total of 22 subjects aged 40 and above with mild and moderate OA knee were assigned to either passive knee mobilization plus conventional physiotherapy (experimental group) or conventional physiotherapy alone (control group). Both groups received 2 therapy sessions per week, for 4 weeks. A blinded assessor measured pain with Visual analogue scale and stairs ascending-descending time with Aggregated Locomotor Function test, at baseline and at week 4. There was a significant reduction in pain among subjects in the experimental group (18.07 mm,  $t = 3.48$ ,  $p = 0.01$ ) compared to the control group (6.66 mm,  $t = 0.44$ ,  $p = 0.67$ ). Non-significant clinical difference was found in stairs ascending-descending time between the two groups (i.e. 6.25s in the experimental group versus 6.78 s in the control group,  $F(1,10) = 0.70$ ,  $p = 0.42$ ). No significant correlation was found between pain score and stairs ascending-descending time,  $r = 0.34$ ,  $p = 0.16$ . The addition of passive joint mobilization to conventional physiotherapy reduced pain but not stairs ascending-descending time among subjects with knee osteoarthritis.*

*Keywords: Mobilization; osteoarthritis; pain*

### ABSTRAK

*Satu kajian terkawal rabun sebelah telah dijalankan bagi menentukan kesan mobilisasi pasif sendi terhadap kesakitan dan masa naik-turun tangga di kalangan pesakit arthritis lutut. Sejumlah 22 subjek berumur 40 tahun ke atas yang menghidapi arthritis ringan dan sederhana dirawak bagi menerima rawatan mobilisasi pasif sendi yang digabung dengan fisioterapi konvensional (kumpulan kajian) atau fisioterapi konvensional sahaja (kumpulan kawalan). Kedua-dua kumpulan menerima 2 sesi rawatan seminggu, selama 4 minggu. Seorang penilai rabun mengukur tahap kesakitan menggunakan skala analog visual dan masa naik-turun tangga menggunakan ujian Aggregated Locomotor Function, di awal kajian dan pada minggu ke-4. Tahap kesakitan berkurangan secara signifikan di kalangan subjek kumpulan kajian (18.07 mm,  $t = 3.48$ ,  $p = 0.01$ ) berbanding kumpulan kawalan (6.66 mm,  $t = 0.44$ ,  $p = 0.67$ ). Tiada perbezaan klinikal yang tekal semasa naik-turun tangga di antara kedua-dua kumpulan (iaitu 6.25 s bagi kumpulan kajian berbanding 6.78 s bagi kumpulan kawalan,  $F(1,10) = 0.70$ ,  $p = 0.42$ ). Tiada hubungan yang bererti ditemui di antara skor kesakitan dengan masa naik-turun tangga,  $r = 0.34$ ,  $p = 0.16$ . Mobilisasi pasif sendi, apabila digabung dengan fisioterapi konvensional mengurangkan kesakitan tetapi tidak untuk tempoh naik-turun tangga.*

*Kata kunci: Kesakitan; mobilisasi sendi; osteoarthritis*

### INTRODUCTION

Osteoarthritis (OA) is the most common form of degenerative joint disease affecting 15 to 40% of people aged 40 and above (Corti & Rigon 2003). One hundred fifty one million people worldwide experienced OA in 2004 which was ranked sixth as a leading cause of moderate and severe disability (World Health Organisation 2008).

The knee is the joint most frequently affected by osteoarthritis. OA knee is two times more prevalent than OA hips in people aged over 60 years (Scott & Kowalczyk 2007), and is a significant contributor of pain and mobility impairment in community-dwelling adults (Corti & Rigon 2003; Symmons et al. 2000). In a general practice setting in Britain, 1% of people aged over 45 years have a currently-

recorded clinical diagnosis of knee osteoarthritis, and 5% will have had the clinical diagnosis made at some point (Bedson et al. 2005).

Clinically, OA knee is characterized by pain during weight bearing, tenderness, limitation of knee movement, crepitus, occasional effusion, and variable degrees of local inflammation (Symmons et al. 2000). Pain is the most frequent reason for patients with OA knee to seek medical attention and rehabilitation (Symmons et al. 2000). If left untreated, pain and stiffness will result in a loss of physical function and self-independence. The presence of OA-related knee pain has also been associated with increase in the risks of physical disability in the community (van Baar 1998).

Management of pain in OA knee is a multidisciplinary approach. Physiotherapy, as a mainstay of conservative treatment for OA knee involves the use of various modalities such as manual therapy, exercises, patellar taping, thermal modalities and electrical stimulations as a direct or an indirect pain reduction measure. Manual therapy includes soft tissue manipulation, massage, manual traction, joint manipulation and joint mobilization (Vicenzino 2001). Joint mobilization which involves low-velocity passive movements within or at the limit of joint range of motion reduces pain by modulating the nervous tissues and increases joint motion (Maitland 2005; Vicenzino 2001).

The use of joint mobilization is recommended in many guidelines for the management of OA knee, yet the evidence underlying its use is limited. Moss and colleagues (2007) in a study of 38 subjects with mild and moderate OA knee examined the effects of accessory joint mobilization on pain and function of the knee. In the study, a 9-minutes mobilization of the tibio-femoral joint was compared with manual contact and non-contact interventions. They concluded that the technique significantly reduced pain and improve functional ability, measured with pressure pain threshold and 3-metre 'up and go' test than the other two techniques. The change in stairs ascending-descending ability and its association with pain was not investigated. This study aimed to evaluate the effects of knee joint mobilization in addition to conventional physiotherapy compared to conventional physiotherapy alone in adult patients with OA knee. Specifically, this study aimed to compare changes in knee pain and stair ascending-descending ability, and assess correlation between knee pain and stairs ascending-descending ability.

#### MATERIALS AND METHODS

A total of 22 subjects aged 40 years and above were recruited from the Physiotherapy Unit of Universiti Kebangsaan Malaysia Medical Centre (UKMMC). The inclusion criteria were sub-acute or chronic OA with pain at least in one knee, able to ambulate independently with or without assistive devices, ascend and descend at least a flight of stair, and willingness to be randomized. The diagnosis of osteoarthritis was made clinically and radiographically by orthopedic specialist. Subjects were excluded if they had acute inflammation, contracture or surgery affecting any knee, fracture of lower limb within the past 6 months, cognitive problems (score <20 on the Mini-Mental State examination), current participation in supervised physical therapy, pain during exercise or unstable medical conditions such as myocardial infarction within the past 6 months, symptomatic coronary artery disease or congestive heart failure, uncontrolled hypertension and acute or terminal illness. All intervention sessions were supervised by a trained physiotherapist. Ethical approval was obtained from the Research and Ethics Committee of National University of Malaysia, and subjects provided written informed consent prior to participation in this study.

Subjects in the intervention group received passive joint mobilization in addition to conventional physiotherapy. Joint mobilization includes antero-posterior (AP) glide of tibia on femur, and patella glides in all directions. Techniques of application were based on guidelines developed by Maitland (2005). Conventional physiotherapy consisted of a set of exercises followed by a 20-minutes thermal therapy with hot pack. The exercise components were chosen based on previous studies (Deyle 2000; Fitzgerald 2005) and comprised of stretches of lower limb muscles (gastrocnemius, soleus and hamstring), isometric quadriceps work, closed-kinetic chain exercise (seated leg press or partial squat or step-up) and static bicycling.

The control group received conventional therapy alone. Both groups were treated twice a week for a total of 4 weeks. Subjects were also advised to continue the given exercise daily at home. An exercise instruction sheet and home program adherence log were provided to facilitate self practice of the exercise programme. All subjects continued their normal medications for the duration of the study.

Measurement of outcomes was carried out by a blinded assessor, at baseline and at week 4. Aggregated Locomotor Function (ALF) (McCarthy & Oldham 2004) was used to measure stair ascending-descending time. The test measured time taken to ascend and descend 7 steps (3 steps with height of 16.5 cm and 4 steps measured 12.0 cm) for 4 repetitions at a comfortable pace. Mean of the 4 repetitions was calculated. Subjects were permitted to use banisters if necessary, as it does not affect times (Deyle 2005). ALF has high reliability (ICC 0.98, CI 95%) and strong correlation ( $r = 0.58$ ) with the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index (McCarthy & Oldham 2004). Pain during stairs ascending-descending was assessed with Visual analog scale (VAS) (Price et al. 1983). Subjects expressed pain on a 10 cm horizontal, with end-points marked 0cm and 10 cm indicated 'no pain' and 'worst pain imaginable', respectively. VAS has high test-retest reliability for measuring pain in musculoskeletal conditions ( $\alpha = 0.71-0.99$ ) (van Duijin et al. 2007).

#### STATISTICAL ANALYSIS

Data were analyzed with SPSS statistical package version 14.0. Mean differences between the variables at baseline were assessed with unpaired t-test (for age, VAS and stairs ascending-descending time), Mann-Whitney U test (for body mass index (BMI) and subjects' duration of symptoms) and Chi square test (for gender, number of affected knee and presence of deformity). Outcome variables were assessed with mixed analysis of variance (for VAS score) and analysis of covariance (for stairs ascending-descending time, with stair ascending-descending time at baseline as the covariate), and paired t-test for within group differences. Spearman Correlation test was used to determine the correlation between VAS and stairs ascending-descending time. Level of significance was set at  $p < 0.05$ .

## RESULTS

A total of 13 subjects (59%) completed the study. Of nine subjects who withdrew during the intervention, 4 were from the experimental group and 5 from the control group. In the experimental group, 2 withdrew due to transportation problem, 1 developed hip pain prior to the intervention, and 1 had to care for a sick family member. In the control group, 3 withdrew due to other commitments, 1 developed pain and swelling of the ankle prior to the intervention, and 1 was excluded after receiving a corticosteroid injection for knee pain. Subjects in the experimental and the control group attended 87.5% and 100% of the therapy sessions, respectively. On completion of the study, data for 2 men and 11 women were available for analysis. There were no significant differences between the two groups in all variables at baseline ( $p > 0.05$ ), except for stairs ascending-descending time (Table I).

Table 2 shows the differences in post-treatment VAS and stairs ascending-descending time between the groups. The mean VAS reduced by  $18.07 \pm 3.82$  mm (44.07%) in the experimental group and by  $6.66 \pm 4.11$  mm (20.44%) in the control group. There were no significant differences for the between-groups effect  $F(1,11) = 2.7$ ,  $p = 0.13$ , but within-group differences demonstrated significant reduction in VAS in the experimental group ( $t(6) = 3.48$ ,  $p = 0.01$ ), compared to the control group ( $t(5) = 0.44$ ,  $p = 0.68$ ). No significant difference was found in stairs ascending-descending time between the two groups,  $F(1,10) = 0.70$ ,  $p = 0.42$ . Spearman Correlation analysis found a moderate but non-significant correlation,  $r = 0.34$ ,  $p = 0.16$ , between pain and stairs ascending-descending time.

## DISCUSSION

The results showed that clinically, inclusion of joint mobilization into a conventional physiotherapy reduces pain greater than conventional physiotherapy alone (44% and 20% respectively). The result is in congruence with the findings by Kumar et al. (2006), who combined complex knee mobilization and electrotherapy, and Moss et al. (2007), who compared tibio-femoral joint mobilization against manual contact and non-contact control procedures, in subjects with mild to moderate knee osteoarthritis. Pain reduction following joint mobilization has been established in previous studies. An in vitro animal study by Sambajon et al. (2003) found a 70% reduction in levels of cellular prostaglandin (PG)  $E_2$ , a strong inflammatory mediator causing hyperalgesia in arthritic joints, within 24 hours of mobilization. Skyba et al. (2003) suggested that analgesic effect following knee joint mobilization was primarily due to enhancement of the descending pain inhibitory pathway in the spinal cord, which utilized serotonergic (5-HT1A) and noradrenergic receptors ( $\alpha$ -2).

No significant gain in stairs ascending-descending ability of osteoarthritic knee was shown in this study. This result does not support the benefit of joint mobilization in improving motor functions as reported in previous similar studies. Sterling et al. (2001), in a study of cervical mobilization, found improvement in deep neck flexor function in subjects with neck pain. In another study, Vicenzino et al. (2001) found that mobilization with movement on elbow joint improved pain-free grip in subjects with lateral epicondylalgia. The improvement

TABLE 1. Characteristics of the two groups at baseline

Variables	Control (n=6)	Experimental (n=7)	p value
Mean age $\pm$ SD, year	59.7 $\pm$ 4.9	63.1 $\pm$ 10.8	0.47*
Gender	5	6	1.0#
Female	1	1	
Male			
BMI (median, range), kg/m <sup>2</sup>	26.2(23.6-39.3)	28.5(21.7-40.0)	0.57‡
OA duration (median, range), year	2.0(0.75-3.0)	1.2(1.0-10.0)	0.94‡
Knee affected			
Unilateral	1	1	1.0#
Bilateral	5	6	
Valgus/varus deformity			
Yes	2	4	0.59#
No	4	3	
Mean VAS $\pm$ SD, mm	32.58 $\pm$ 21.09	41.00 $\pm$ 20.86	0.57.*
Stairs ascending-descending time (mean $\pm$ SD), s	5.93 $\pm$ 1.17	8.75 $\pm$ 1.77	0.007*

\*unpaired t test

#Chi-square test

‡Mann-Whitney U test

TABLE 2. Post-treatment VAS and adjusted stairs ascending-descending time

	Control (n=6)	Experimental (n=7)	Mixed ANOVA (F, p value)	ANCOVA (F, p value)
VAS (Mean±SD), mm				
Baseline	32.58 ± 21.09	41.00 ± 20.86		
At 4 weeks	25.92 ± 16.98	22.93 ± 17.04	0.07, 0.80	
Within group differences	6.66 ± 4.11	18.07± 3.82		
Paired t test (t, p value)	0.44, 0.67	3.48, 0.01*		
#Stairs ascending-descending time (Mean ± S.D), s	6.78 ± 0.41	6.25 ± 0.37		0.70, 0.42

\* p is significant at 0.05

# adjusted for stairs ascending-descending time at baseline

in motor activities following joint mobilization has been associated with hypoalgesic and sympatho-excitatory responses produced during the procedure. The lack of power in this study has minimized our ability to detect these effects among our subjects.

This study showed that pain has no correlation with stairs ascending-descending time of osteoarthritic knee. Current result is consistent with findings from Harrison (2004), who found positive correlation between pain and self-reported functional difficulty but not physical performance. Difficulty in performing functional activity in individuals with OA knee can be attributed to many factors besides pain, such as quadriceps inhibition, obesity, knee laxity, knee alignment, fear of physical activity and self-efficacy (Fitzgerald 2005).

The findings of this study are subjected to several limitations. Large drop-outs in both the experimental and the control groups have threatened the validity of the study findings. At completion of the study, data from only 13 subjects (59%) were analysed. Another limitation is the lack of experience of the therapist who applied joint mobilization on the subjects. In UKMMC, the therapists are relatively young and have not gained adequate skills in manual therapy, thus mobilization techniques intervened might not be as effective as it could have been. Cleland et al. (2004) who compared novice with expert clinicians in inducing peripheral sympathetic nervous system activity through thoracic mobilization, demonstrated that expert clinicians were more effective than their novice counterparts. In this study, other factors that influence stairs ascending-descending performance, such as quadriceps inhibition, obesity, knee laxity and self-efficacy were also not controlled to elicit results that were true to the joint mobilization technique.

#### CONCLUSION

Despite its limitations, this study demonstrated that joint mobilizations when combined with conventional physiotherapy, reduced pain in patients with OA knee.

Further studies with larger samples are required to establish the benefit and applicability of this technique on osteoarthritis of the knee.

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