# Six sessions of manual therapy increase knee flexion and improve activity in people with anterior knee pain: a randomised controlled trial

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**Question**: What are the effects of manual therapy on pain, range of motion, and activity in patients with anterior knee pain? **Design**: Randomised controlled trial. **Participants**: Thirty-eight ambulatory care patients (one dropout) with anterior knee pain. **Intervention**: The experimental intervention consisted of six sessions of manual therapy, while the control intervention was to remain on the waiting list for two weeks. **Outcome measures**: Pain was measured using the Patellofemoral Pain Severity Questionnaire. Active knee flexion and extension was measured from photographs. Activity was measured by having the participants step up and down a 15 cm step, leading with the painful leg as many times as they could in a 60 second period. Measurements were taken before and after intervention by a blinded assessor. **Results**: The experimental group decreased their pain by –8 mm (95% CI –17 to 1, $p = 0.08$) and pain on stairs by –10 mm (95% CI –22 to 2, $p = 0.10$) compared with the control group. They increased their active knee flexion by 10 deg (95% CI 4 to 16, $p = 0.004$) and the number of steps in 60 seconds by 5 (95% CI 2 to 8, $p = 0.001$) compared with the control group. **Conclusion**: Manual therapy is effective in improving knee flexion and stair climbing in patients with anterior knee pain. There is a trend towards a small improvement in pain. **[van den Dolder PA, Roberts DL (2006) Six sessions of manual therapy increase knee flexion and improve activity in people with anterior knee pain: a randomised controlled trial. *Australian Journal of Physiotherapy* 261–264]**

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## Introduction

Knee pain is one of the most commonly reported musculoskeletal disorders with estimates that it will affect 30–40% of the population by age 65 (van Saase et al 1989). Anterior knee pain is the most prevalent disorder involving the knee, with its prevalence being as high as 7% at any one time in active young adults (Witvrouw et al 2000). It is usually located in the retropatellar or peripatellar regions and is described as a dull ache or throbbing feeling (Fulkerson and Arendt 2000). The pain is usually aggravated by activities that involve increased patellofemoral compressive forces such as ascending or descending stairs, sitting with the knees bent, kneeling, and squatting (Fulkerson 1983, Fulkerson and Arendt 2000, Sanchis-Alfonso and Rosello-Sastre 2000). Although the exact mechanism behind the aetiology of anterior knee pain remains unclear, it is likely that it is multifactorial (Juhn 1999). Mechanical factors such as lateral tracking of the patella due to poor biomechanical alignment of the lower limb, delayed onset of the vastus medialis obliquus muscle during knee activities and tight lateral structures around the patellofemoral joint have been proposed (Juhn 1999, Cowan et al 2003).

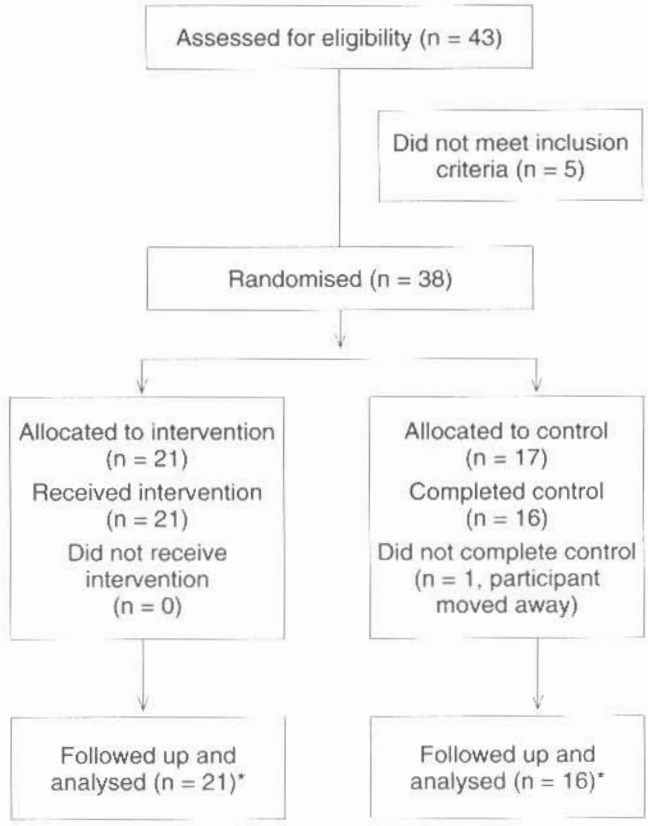
It has been demonstrated that physiotherapy intervention is effective in reducing pain and improving activity in people with anterior knee pain (Crossley et al 2002; Cowan et al 2003; Harrison et al 1999). These studies have included combinations of patellofemoral taping, muscle stretching, strengthening and co-ordination exercises, along with techniques aimed at decreasing tightness of the lateral structures such as patellofemoral mobilisation and deep friction massage to the lateral soft tissues of the knee. It is not yet known, however, which components may be individually responsible for the improvement. Manual therapy techniques including mobilisation, stretching, and soft tissue massage are used in the treatment of anterior knee pain with the aim of decreasing tightness of the lateral structures (Cyriax 1977). The aim of this trial was to assess the efficacy of manual therapy for anterior knee pain.

## Method

***Design*** A randomised controlled trial was undertaken. Upon initial interview, patients were screened by an independent assessor (Magee 1992) to determine their eligibility for the study. If eligible, written consent was obtained and an assessor proceeded to collect baseline measures of pain, range of motion, and activity limitations. Participants were then randomly allocated to either the experimental or the control group by selection of a sealed envelope from a container of identical envelopes by a person independent of assessment or intervention. This ensured concealed randomisation and blinding of the assessor to allocation. Blinding of the patients to allocation was not possible. The experimental intervention consisted of six sessions of manual therapy, whereas the control intervention was to remain on the waiting list for two weeks. Post-intervention measures were taken two days after the completion of treatment to decrease the chance that only the effect of the

**Table 1.** Characteristics of participants.

| Characteristic | Experimental group (n = 21) | Control group (n = 16) | Dropouts (n = 1) |
|---|---|---|---|
| Age (*yr*) Mean (SD) | 55 (11) | 52 (18) | 49 |
| Gender Male:Female | 4:17 | 6:10 | Female |
| Chronicity (*wk*) Median (IRQ) | 26 (12 to 91) | 39 (15 to 137) | 78 |




*There are some missing data for some measurements due to data collection error. These are set out in Table 2.

Figure 1. Flow of participants through the trial.

last treatment was measured. Participants were shown their baseline responses to questionnaires immediately prior to filling them out again to improve the reliability of responses (Guyatt et al 1985). The study was approved by both the Central Sydney Area Health Service and the Western Sydney Area Health Service Human Ethics Committees.

***Participants*** Participants were recruited from patients referred to the Physiotherapy Departments of either Auburn Hospital or Concord Repatriation General Hospital, Sydney, Australia, for management of anterior knee pain. Patients were included in the trial if they were between the ages of 18 and 80 and were able to understand spoken English. They were excluded if their knee pain was caused by trauma in the preceding four weeks, was reproduced with combined extension/rotation and side flexion of the lumbar spine to the ipsilateral side or on hip quadrant with overpressure, was due to infection or a neoplastic disorder, was of an acute inflammatory nature, or if they had undergone knee surgery within the past six weeks. They were also excluded if there was no palpable tenderness over the lateral patellofemoral joint, since this type of manual therapy would not normally be used in this situation (Cyriax 1984).

***Intervention*** The experimental group received six sessions of manual therapy consisting of transverse frictions to the lateral retinaculum as described by Cyriax (1984) conducted both in the fully extended and fully flexed position, tilt patellofemoral stretches as described by Brukner et al (2001), and the application of a sustained medial glide during repeated flexion and extension of the knee. Each session lasted for 15–20 minutes and was performed as the treating therapist saw fit. No other intervention (such as advice or exercise) was given to the experimental group during the trial. The control group remained on the waiting list.

***Outcome measures*** Pain was measured using the Patellofemoral Pain Severity Questionnaire (Laprade and Culham 2001). The questionnaire consists of 100 mm visual analogue scales of pain for ten common activities that often provoke anterior knee pain. These range from sedentary activities such as sitting and resting to vigorous activities including running/sprinting and participating in sport. Participants were instructed to mark the average level of pain that they had experienced in the previous week for a particular activity on a scale labelled 'none' at one end and 'unbearable' at the other. This was then measured in millimetres from the 'none' end of the scale. If the participants had not attempted the particular activity, they recorded 'not attempted'. To enable meaningful comparison, the individual scores were averaged to produce a single score. The Patellofemoral Pain Severity Questionnaire has been shown to have excellent test-retest reliability ($r_s = 0.95$) and a high degree of concurrent validity when compared with the Western Ontario MacMaster and Hughston scales (Laprade and Culham 2001). As pain on ascending and descending stairs is common amongst patient with anterior knee pain, the score for this activity was considered separately as well as within the average score.

Active knee flexion and extension was assessed with participants in supine. Adhesive dots were placed on the greater trochanter of the hip, the lateral collateral ligament of the knee, and the lateral malleolus of the ankle (Norkin 1995). Participants were then instructed to move their knee either into flexion or extension as far as they could (as limited by pain, weakness, or resistance to movement). Photographs were taken perpendicular to the plane of movement at the level of the knee. Knee angle was calculated between the bisecting lines drawn between the greater trochanter and the lateral collateral ligament, and the lateral malleolus and the collateral ligament. As there was a different blinded assessor at the two sites, their inter-rater reliability was assessed. A reliability study of 10 patients with anterior knee pain with the two assessors measuring them 10 minutes apart produced an $ICC_{(2,1)}$ for flexion of 0.95 and for extension of 0.39.

Activity was measured using a step test. The participants were instructed to step up and down a 15 cm step, leading

**Table 2.** Mean (SD) score, mean (SD) difference within groups, and mean (95% CI) difference between groups for all outcomes for the experimental group and the control group.

| Outcome | Score | | | | Difference within groups | | Difference between groups |
|---|---|---|---|---|---|---|---|
| | Week 0 | | Week 2 | | Week 2 minus Week 0 | | Week 2 minus Week 0 |
| | Exp n = 21 | Con n = 17 | Exp n = 21 | Con n = 16 | Exp n = 21 | Con n = 16 | Exp minus Con |
| Pain | | | | | | | |
| Average PFPSQ *(mm)* | 50 (23) | 51 (22) | 40 (4) | 49 (24) | −10 (16) | −2 (10) | −8 (−17 to 1) |
| Stairs PFPSQ *(mm)* | 57 (23) | 64 (29) | 42 (26) | 61 (29) | −15 (20) | −5 (15) | −10 (−22 to 2) |
| Active knee ROM | | | | | | | |
| Flexion *(deg)* | 123 (21) n = 20* | 126 (8) | 130 (13) n = 20* | 126 (8) n = 15* | 10 (13) n = 20* | 0 (4) n = 15* | 10 (4 to 16) |
| Extension *(deg)* | −6 (6) n = 20* | −4 (6) | −4 (6) n = 20* | −4 (5) | 2 (4) n = 20* | 1 (4) | 0 (−2 to 3) |
| Activity | | | | | | | |
| Step Test *(number/60s)* | 20 (7) | 26 (12) | 24 (9) n = 20* | 25 (15) | 5 (3) n = 20* | −1 (5) | 5 (2 to 8) |

PFPSQ = Patellofemoral Pain Severity Questionnaire, ROM = range of motion, Exp = experimental, Con = control. *data missing for one participant.

with their painful leg, as many times as they could for 60 seconds. The reliability study produced an $ICC_{(2,1)}$ of 0.96 for this measure.

Finally, participants in the experimental group were asked to fill out their satisfaction with treatment using the words 'very satisfied', 'somewhat satisfied', 'somewhat dissatisfied' or 'very dissatisfied'.

***Data analysis*** Sample size was calculated on a predetermined difference in change scores between the experimental and control groups of 20 mm on the Patellofemoral Pain Severity Questionnaire. This was based on what was believed to be a clinically-worthwhile effect. Sample size calculations, assuming a standard deviation of 20% and a dropout rate of 10%, indicated the need for 19 participants in each group.

Two-tailed independent-sample *t*-tests were used to calculate 95% CI for between-group comparisons for change in pain, range of motion, and step test scores. Analysis of data was on an intention-to-treat basis.

## Results

***Flow of participants through the trial*** Thirty-eight patients (mean age 54 years) were admitted to the study. The characteristics of the two groups are shown in Table 1 and their progress through the trial is shown in Figure 1. Random allocation generated groups that were comparable in terms of age, reported disability, and range of motion. Chronicity was greater in the control group but both groups showed marked levels of chronicity. One of the participants dropped out of the trial for personal reasons, resulting in a follow-up rate of 97%.

***Compliance with trial method*** Participants allocated to the experimental group received on average 5.8 sessions over approximately two weeks (range 14 to 24 days).

***Effect of intervention*** The experimental group reduced their pain by −8 mm (95% CI −17 to 1, $p = 0.08$) and pain on stairs by −10 mm (95% CI −22 to 2, $p = 0.10$) compared with the control group. They increased their knee flexion by 10 deg (95% CI 4 to 16, $p = 0.004$) but knee extension did not change (0 deg, 95% CI −2 to 3, $p = 0.78$) compared with the control group. However, they increased the number of steps in 60 seconds by 5 (95% CI 2 to 8, $p = 0.001$) compared with the control group (Table 2, see Table 3 on the eAddenda for the complete dataset).

Of the 21 participants in the experimental group, six reported that they were very satisfied with treatment, 13 indicated that they were somewhat satisfied, and two indicated that they were very dissatisfied with treatment.

## Discussion

This randomised, controlled trial demonstrated that six sessions of manual therapy to the lateral aspect of the patello-femoral joint results in significantly greater improvement in active knee flexion and the ability to step up/down a step in people with anterior knee pain than does no intervention. There was also a trend towards a decrease in pain. The study may have been insufficiently powered to detect a significant change in pain, a sufficient amount of intervention may not have been provided, or there may have been no difference between the two groups. The participants in this trial were relatively old and it may be possible that there would be a better response to this intervention in younger patients. Future studies in this area need larger cohorts to more definitely examine whether manual therapy

decreases pain in people with anterior knee pain. Other studies that have shown a decrease in pain and disability in people with anterior knee pain have used combinations of interventions such as quadriceps retraining, patellofemoral joint mobilisations, and patellar taping compared to placebo (Bennell et al 2005, Crossley et al 2002), whereas our study investigated the effectiveness of manual therapy in isolation.

Because of the nature of the intervention, it was not possible to blind the participants or the therapists to allocation. One of the limitations of this study was that the control group remained on the waiting list rather than receiving a sham intervention. This means that, at least in part, these results could be explained by a placebo or Hawthorne effect. However, there were no significant improvements in any of the measures for the control group between baseline and post-waiting list assessment (Table 2). This suggests that in this population, there was little spontaneous recovery in two weeks. In addition, the effect of manual therapy was measured only two days after the cessation of intervention and so the long-term effect remains unknown. The inclusion of a placebo group and long-term follow-up would be useful in future studies.

Little scientific information exists to explain the morphological and functional effects of mobilisation, soft tissue massage, and stretching in *in vivo* human tissue. *In vitro* animal studies have demonstrated that soft tissue massage can result in increased fibroblast proliferation in the tendons of rats compared to no treatment (Davidson et al 1997). Other authors have theorised that the mechanical strain applied during soft tissue massage could aid in the remodelling of immature and weak scar tissue from fibres oriented in all directions and several planes into linearly-rearranged bundles of connective tissue (Hardy 1989). Extrapolated to the patellofemoral joint, this would produce an increase in mobility and therefore explain the improvement in knee flexion. Neuroanatomical studies of portions of the lateral retinaculum excised during operations on patients with anterior knee pain have demonstrated a greater distribution of nerve fibres and neural growth factor than in patients without anterior knee pain (Sanchis-Alfonso et al 2000). This could indicate a possible neuroanatomical basis for the increased pain found in the lateral patellofemoral region of patients with anterior knee pain. Further research is required to clarify this hypothesis.

In conclusion, six sessions of manual therapy to the lateral aspect of the patellofemoral joint in patients with anterior knee pain produces significantly greater active knee flexion and improved stair climbing compared with no intervention.

***eAddenda*** Table 3 complete dataset for the study.

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