Physiotherapy in knee osteoarthrosis: effect on pain and walking

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ABSTRACT *Patients with knee osteoarthrosis are often referred for physiotherapy and many different types of treatment are given. The value of many of these treatments has been questioned. This study was intended to evaluate the effect of commonly used physiotherapy treatments in a training programme on patients with medial knee osteoarthrosis, scheduled for surgery. The results from this study also provide useful data for further evaluation of different physiotherapy treatments to this patient group. Thirty-four patients were randomised to physiotherapy three times a week for 5 weeks and the other 34 received no treatment. The training programme is described in detail. The patients were evaluated by clinical examination, step test, gait analysis and isokinetic measurements of thigh muscle strength before and after treatment. The patients in the treatment group experienced a feeling of overall improvement in the knee and the ability to descend steps improved when compared to the control group. There were no significant differences in gait, range of motion or isokinetic measurements of muscle strength between the groups. We conclude that physiotherapy as given here made our patients feel better and their ability to descend stairs improved. These improvements are beneficial to the patients and support the positive effects of exercises and activity. Whilst the objective improvements were small, suggesting that this treatment may not be justified, patients in the treatment group believed that they were improved.*

Key words: knee, osteoarthrosis, physiotherapy.

INTRODUCTION

Knee pain (especially during walking and stair-climbing), occasional swelling, decreased range of motion (ROM) and decreased thigh muscle strength are common

symptoms in knee osteoarthrosis (Murray et al., 1985; Kroll et al., 1989; Steiner et al., 1989). Patients with osteoarthrosis of the knee are often referred for physiotherapy. The aim of this treatment is to reduce pain and increase the ROM and thigh muscle strength. Many different types of physiotherapy treatment programmes have been given, but the effect of treatment on pain, ROM and knee function has not yet been thoroughly investigated.

Gait analysis has been used in several studies to evaluate the outcome of surgical treatment in patients with knee osteoarthrosis. Before surgery, walking speed was reduced to two-thirds of free walking speed of healthy subjects (Kettelkamp et al., 1976; Chao et al., 1980; Berman et al., 1987; Kroll et al., 1989; Steiner et al., 1989; Mattsson et al., 1990).

The aim of this study was to evaluate the effects of commonly used physiotherapy treatments in a training programme in patients with medial knee osteoarthrosis, scheduled for surgery. The postoperative effect was not analysed. The results from this study provide useful data for further evaluation of different physiotherapy treatments in this patient group.

SUBJECTS

Sixty-eight patients, aged between 55–70 years, with medial knee osteoarthrosis grade I–III according to the classification based on weight-bearing radiographs (Ahlbäck, 1968) participated in the study. The patients had had symptoms from their knee joints for 3–10 years (mean 7.5 years). They were all scheduled for surgery, either a high tibial osteotomy or prosthetic replacement, due to symptoms — mainly pain — from their osteoarthrotic knee. The symptoms were strictly unilateral and there were no symptoms from hip or ankle joints. All the patients were informed at entry to the study that some of them were going to attend a physiotherapy group before surgery. Sixty-eight patients were prospectively assigned by use of random allocation methods to either a training programme (n=34) or to a control group (n=34). The control group undertook the same evaluation tests but did not receive physiotherapy treatment (Table 1). Ethical permission was obtained. The patients were chosen by drawing numbers at random. There was no change in medication during the training period.

TABLE 1: Patient data. Mean values (±SD) are presented. The numbers of patients with osteoarthrosis grades I, II and III are presented

	Treatment group (n=34)	*Control group (n=34)*
Average age (years)	64 (±4)	64 (±5)
Average body weight (kg)	85 (±13)	80 (±12)
Average height (m)	1.73 (±0.08)	1.7 (±0.08)
Gender (M/F)	17/17	17/17
Osteoarthrosis grade I	7	8
Osteoarthrosis grade II	15	13
Osteoarthrosis grade III	12	13

METHOD

Physiotherapy

A pragmatic approach to physiotherapy in patients with knee osteoarthrosis was chosen. All patients attended as outpatients. The training programme was aimed at increasing the strength and ROM of the involved knee as well as strength of the whole leg. Exercises were undertaken in groups three times a week during a 5-week period, 15 times altogether. The patients were also instructed to perform the same exercises at home twice a week. The physiotherapist encouraged patients to carry on with their home exercises during the training period.

All patients were examined twice, on entry to the study and 3 months later, as close to the end of the training period as possible. All patients in both groups attended for assessments. All examinations were made by an independent physiotherapist.

The exercises comprised:

- Warming up for 10 min with ergonometer bicycling without resistance.
- Knee extension, from 90° knee flexion to maximal extension, sitting with 1–3 kg around the ankle (depending on strength and pain).
- Knee flexion, from 90° to maximal flexion, sitting.
- Standing on heel and toes.
- Flexion of the involved knee (bringing the heel towards the gluteal muscles) standing with hips straight.
- Hamstrings muscle stretch, standing.
- Hip abduction, sidelying.
- Hip extension, prone position.
- Passive knee extension with both legs straight and a small pillow under the ankle of the affected leg, followed by quadriceps setting, sitting.

The exercises were performed with 2 × 10 repetitions and each exercise was performed with 10 sec of isometric hold. Hamstrings stretching (starting with 10 sec of isometric hold, 2–3 sec of relaxation, followed by 10 sec of muscle stretch) and quadriceps setting were performed five times. The quadriceps strengthening exercise was performed without weights to start with. Resistance increased according to the 10 RM principle (DeLorme, 1951). Three kilograms was chosen as the maximum weight. Sixty per cent of the patients managed to exercise with maximum weights. The programme took 40 min to complete. The control group did not receive any treatment.

Clinical examination

Patients' opinion

The patients were asked to classify, on a 3-grade scale, whether overall knee function was improved, unchanged or worse.

Pain during walking

Pain during walking at self-selected walking speed was assessed by use of an 11-grade category scale (Borg, 1982; Mattsson et al., 1990). Patients were asked to walk for 4 minutes in a corridor 75 m long. At the end of this walking test, they were asked to grade their pain: '0' meant *no pain* and '10' meant the *worst possible pain.*

Passive ROM

Passive range of knee flexion and extension was assessed in the supine position, with a long arm goniometer to the nearest 5°.

Functional test

Ability to step up and down

The ability to flex and extend the knee joint while bearing weight was tested (Waugh et al., 1981). Patients were asked to step up to and down from a set of platforms 0.05, 0.1, 0.15, 0.2, 0.25, 0.3 and 0.35 m high, respectively, with the affected leg leading up and following down. The highest platform at which the knee could do this without support, except for balance, was noted. The result was judged as improved if a higher platform could be reached on the second test occasion.

Muscle performance

Muscle strength was measured isokinetically at 30°/sec with a Cybex II dynamometer (Cybex Div. of Lumex Inc., Ronkonkoma NY, USA) modified according to Gransberg and Knutsson (1983). The torque, as a measure of muscle force, of the knee extensor and flexor muscles was recorded in the limb planned for surgery. Torque curves were accepted only when three repeated tests gave similar results. The peak torque value was calculated as an average of the three highest values recorded every 5° of the torque curve.

Forceplate walkway with electrogoniometers

The walkway used for gait analysis consisted of two 5 m long force-measuring platforms (Olsson et al., 1986) (Figure 1). These long forceplates provide a continuous record of a sequence of several steps taken by both feet thus avoiding the problems connected with use of the usual small forceplate. The walkway was used for evaluation of the following parameters:

- Free walking speed (m/sec).
- Step frequency (steps/sec).
- Stride length/lower extremity length.
- Single stance phase (% gait cycle) of each leg.

These tests were based on approximately 35 gait cycles.

Knee motion during walking was measured with electrogoniometers and based on approximately 10 gait cycles and comparison to the uninvolved leg was made (Olsson et al., 1986).

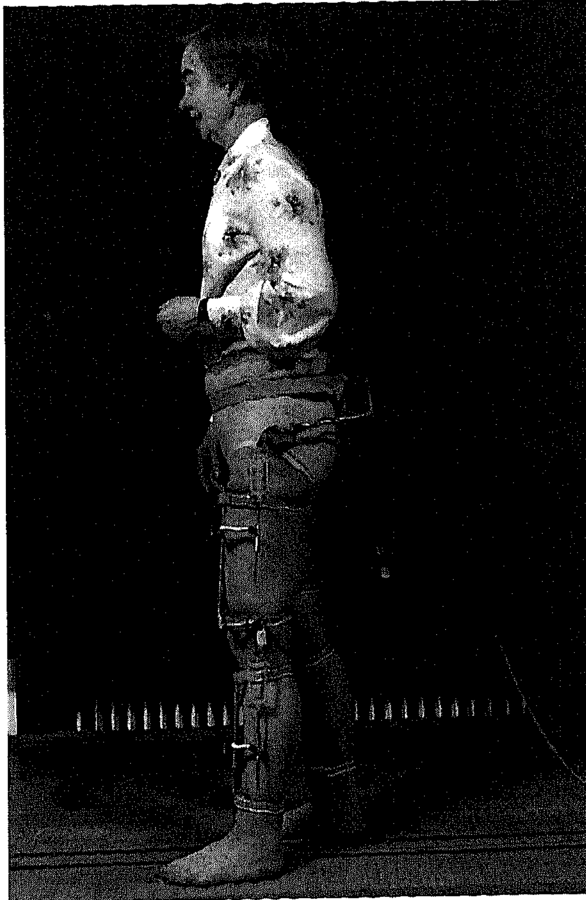

FIGURE 1: A patient on the forceplate walkway with the electrogoniometer mounted on the legs.

Statistics

Individual differences (within-group differences) were tested by use of a paired two-tailed Student's *t*-test for the parametric parameters. Wilcoxon's matched-pairs signed-ranks test was used to test the individual differences in pain during walking before and after treatment. Differences between the groups were tested by use of a two-tailed Student's *t*-test for parametric parameters. The Mann–Whitney U-test was used to test differences between the groups concerning pain during walking. A chi-squared test was used to assess the group differences regarding patient's opinion

of treatment. Fisher's exact test was used to assess the group differences concerning the ability to ascend and descend steps. The level of significance was chosen as $p<0.01$.

RESULTS

All 68 patients completed the study. Due to technical failures, five patients in the treatment group and two in the control group were not tested with the Cybex II dynamometer, and four patients (two in each group) were not tested with the electrogoniometers. Twenty-eight patients in the training group and 30 patients in the control group completed all assessments.

Clinical examination

Patient's opinion

There was a significant improvement in the treatment group but not in the control group (Table 2).

TABLE 2: Results demonstrating the patient's opinion of improvements and the ability to step down after treatment

	Treatment group (n=34)	*Control group (n=34)*
Patient's opinion		
Improved	20	1
Unchanged	10	12
Worse	4	21
Ability to step down		
Improved	13	4
Unchanged	20	22
Worse	1	8

Pain during walking

Pain during walking, averaged 3.0 (*moderate pain*) on the Borg scale, did not change after treatment or between the groups (Table 3).

TABLE 3: Results from pain during walking (by use of an 11-grade category scale*). Mean values (SD) and range

Treatment group (n=34)		*Control group (n=34)*	
Before	*After*	*Before*	*After*
3.4 (2.0) range 0–10	3.0 (1.5) range 0–7	3.3 (1.4) range 1–7	3.3 (1.5) range 0.5–7

*According to Borg (1982).

Passive range of motion

In the treatment group there was a mean flexion contracture of 5° (SD 15°) both before and after treatment. The mean range flexion was 116° (SD 24°) before and 118° (SD 24°) after treatment. In the control group there was a mean flexion contracture of 7° (SD 6°) on both test occasions. The mean range of flexion was 124° (SD 12°) and 120° (SD 20°), respectively. There was no difference between the groups.

Functional test

Ability to step up and down

The ability to ascend steps did not change significantly after treatment or between the groups. The abilty to descend steps improved in 13 patients in the treatment group compared to four in the control group. One patient in the treatment group performed worse on the second test compared to eight in the control group (Table 2 above). The difference between the groups was significant.

Muscle performance

There were no differences in mean peak torque values for the knee extensor and flexor muscles in either group after treatment and no difference between the groups (Table 4). Most patients experienced knee pain during the tests.

TABLE 4: Results from the Cybex II isokinetic dynamometer tests. Peak torque in the knee extensor and flexor muscles. Mean values (±SD)

	Treatment group (n=29)		*Control group* (n=32)	
	Before	*After*	*Before*	*After*
Knee extensors (Nm)	98 (±37)	100 (±46)	96 (±40)	88 (±39)
Knee flexors (Nm)	60 (±28)	66 (±32)	63 (±30)	60 (±29)

Forceplate walkway with electrogoniometers

There was no difference between the groups concerning free walking speed, step frequency and stride length/lower extremity length (Table 5). Single stance phase of the involved leg, 35% of gait cycle in relation to 36% of the uninvolved side, did not change significantly between the groups. The range of stance knee flexion of the involved leg during walking, with a mean value of 11° (uninvolved 17°) did not change between the groups. The range of swing knee flexion of the involved leg during walking, with a mean value of 53° (uninvolved 59°) did not change between the groups.

TABLE 5: Results from forceplate walkway before and after treatment. Mean values (±SD)				
	Treatment group (n=34)		*Control group (n=34)*	
	Before	*After*	*Before*	*After*
Walking speed (m/sec)	1.01 (±0.17)	1.09 (±0.17)	1.09 (±0.20)	1.11 (±0.18)
Step frequency (steps/sec)	1.64 (±0.16)	1.73 (±0.12)	1.72 (±0.17)	1.74 (±0.14)
Stride length/lower extremity length	1.32 (±0.16)	1.38 (±0.18)	1.36 (±0.15)	1.37 (±0.14)

DISCUSSION

After a physiotherapy training programme consisting mainly of exercises to increase muscle strength and ROM, patients reported a feeling of overall improvement of the knee. This was in accordance with an improved ability to descend steps. There was a tendency to increased free walking speed, step length and stride length/lower extremity length in the training group, but not in the control group. Free walking speed increased with increased step frequency and step length, which is a normal way of increasing walking speed.

The biggest difference between the groups was the subjective improvement reported by 20 of 34 patients in the treatment group. This subjective improvement was much larger than the objectively measured improvement. To what extent this was an effect of the time spent with the therapist could not be evaluated since the control group did not receive any placebo treatment.

The passive and active range of knee motion did not improve after treatment, probably due to the large initial range of motion.

The improved ability to descend steps and the tendency to increased free walking speed after physiotherapy indicate an increase in leg muscle strength, which we were not able to confirm with our isokinetic measurements of thigh muscle strength. The fact that most of the patients experienced knee pain during the tests gave us the impression that their pain influenced their performance and therefore measurement of muscle strength. This is in accordance with other reports showing very low correlations between muscle torque, functional measurements and walking ability in patients with knee osteoarthrosis (Lankhorst et al., 1982, 1985). The value of isokinetic muscle strength measurements for documentation of the effectiveness of physiotherapy services has also been questioned (Rothstein et al., 1987).

The most demanding function of the knee joint is to flex and extend whilst bearing weight. We used a step test (Waugh et al., 1981) to assess this function. Our highest step was 35 cm, which was too low, as half the patients managed that height at the first attempt. If the steps had been higher we might also have found a difference in the ability to ascend steps, since we judged the result as *improved* if a higher platform could be reached on the second test occasion. However, the ability to descend (from a higher platform than before) improved significantly, although 17 patients managed the highest step at their first attempt. To descend a step taking the uninvolved leg first, causes weight-bearing on the affected knee joint and can be interpreted as an improvement due to increased muscle strength.

All our patients had knee symptoms, mainly pain, severe enough to indicate surgical treatment on entry to the study. Thus, the knee pain experienced by our patients limited their ability to perform effective training in order to increase thigh muscle strength.

On the basis of this study we are now planning a study in patients with less pronounced osteoarthrosis of the knee.

CONCLUSION

Physiotherapy, as given here, made our patients feel better according to their own opinion, and the ability to descend steps improved. However, our data do not support the continued use of this type of therapy in patients with osteoarthrosis of the knee before surgery.

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