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Acupuncture Treatment of Patellofemoral Pain Syndrome

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ABSTRACT

Objective: To evaluate the effect of acupuncture treatment in patellofemoral pain syndrome.

Design: A controlled trial where patients were randomly assigned either to acupuncture treatment or no treatment. Evaluation of the result was blinded.

Setting: An acupuncture/physiotherapy treatment practice in Bergen, Norway.

Subjects: A total of 75 patients with patellofemoral pain syndrome were included, of whom 44 were female.

Intervention: Individualized acupuncture treatment twice weekly for 4 weeks.

Main Outcome Measure: Patients were followed for 1 year with the Cincinnati Knee Rating System (CKRS) scale as the main outcome measure. Other tests used were the Stairs-Hopple test, quadriceps atrophy, and evaluating level pain after activity by a visual analogue scale.

Results: At inclusion patients, aged 18–45 (mean 31.0) years, reported persistent pain on activity (mean 6.6 years) and at rest (mean 4.3 years). CRS scores at baseline were similar (acupuncture group 58.0 versus no treatment group 56.1). At 12 months there was a significant difference in the CRS score between the groups (acupuncture 75.2 versus no treatment 61.7, $p = 0.005$). When analyzing for worst case, the difference persisted (68.1 versus 54.4, $p = 0.03$). Results were then dichotomized as to whether the patient was cured or not at 12 months. A patient was defined as cured if he/she scored "slight" or "none" on the "pain" or "limitation to activity" subscales. The Number Necessary to Treat (NNT) to cure one patient was NNT = 3.0 for the CRS pain subscale and NNT = 3.7 for the CRS function subscale.

Conclusion: We conclude that acupuncture may be an alternative treatment for patellofemoral pain syndrome.

INTRODUCTION

Patellofemoral pain syndrome is a clinical entity of uncertain etiology (Arrol et al., 1997). It is the leading cause of chronic knee pain in young adults, and it may affect as many as 15% of young men in military service (Milgrom et al., 1991). Adolescents participating in sports seem to be particularly vulnerable to knee problems (Kannus et al., 1987), and the patellofemoral pain syndrome is one of the most common diagnoses at sports medicine centers (Baquie and Brukner, 1997).

Various terms have been applied to the syn-

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drome in recent years, such as chondromalacia patellae. The current terminology is patellofemoral pain syndrome (Arrol et al., 1997). Symptoms include chronic knee pain of insidious onset aggravated by walking uphill or downhill, squatting, kneeling, or prolonged sitting with flexed knees (Arrol et al., 1997). Whereas Galanty et al. (1994) found significant correlation between anterior knee pain and several historical variables such as current pain, pain on exercise, pain on stair climbing, the theater sign (prolonged sitting), and pain on routine activity, there was no correlation with knee extension or flexion, femoral rotation, or quadriceps angle. Furthermore, there seems to be no correlation between the degree of cartilage damage evaluated by arthroscopy and symptoms or function (Karlsson et al., 1996).

There are few controlled trials on patellofemoral pain syndrome. Arrol et al. (1997) found only five studies meeting their criteria in a recent review article. Two controlled trials administering intra-articular or intramuscular injection of glycosaminglycan yielded conflicting results (Kannus et al., 1992; Raatikainen et al., 1990). Eng and Pierrynowsky (1993) found that insoles with hindfoot and forefoot wedging were superior to flat insoles after 8 weeks of use, and Finestone et al. (1993) found no effect of an elastic knee support.

In the absence of other treatments, unconventional treatment may be used. Acupuncture has had promising results in the treatment of gonarthrosis (Berman et al., 1995; Christensen et al., 1992; Junnilla, 1982; Zwölfer et al., 1992). This study evaluates the effect of acupuncture on patellofemoral pain syndrome.

MATERIALS AND METHODS

Patients were recruited by advertisement and by case-finding in orthopedic and physiotherapeutic practices. A total of 117 patients responded. Forty-two were excluded because they did not meet the inclusion criteria. Thus, a total of 75 patients with patellofemoral pain syndrome were recruited in the Bergen, Norway area during 19 months from April 1995 to November 1996.

Patients aged 18 to 45 years were included if they had pain in one or both knees during activity or at rest consistent with patellofemoral pain syndrome (whether or not they had experienced pseudo-locking of the knee) as long as no other more specific knee disorder had been diagnosed or was found at inclusion. Patients having received acupuncture in the last 12 months or steroid treatment in the last 3 months were excluded. For inclusion, patients had to be able to participate in active daily life. The patients' informed consent was obtained.

Patellofemoral pain syndrome was defined as pain in one or both knees during activity (exercise, stair climbing, or routine activity) or rest (squatting or prolonged sitting with bent knees), without another more specific knee disorder (Arrol et al., 1997).

Patients were randomly assigned in groups of four either to acupuncture treatment or no treatment. The acupuncture treatment was based on an individual acupuncture diagnosis of each patient. All were needled locally at ST-34 and SP-10, and either Extra point Lower Extremity–5 and ST-35 or SP-9 and ST-36. Other points used were BL-17, 18, 20, 23; LI-4; CV-4. Each session lasted 20 to 25 minutes, and the needles were initially manipulated until *de-qi* was obtained. The acupuncture treatment was repeated twice weekly for 4 weeks. The acupuncturist (R.J.) had 10 years of clinical acupuncture practice after receiving his licentiate in acupuncture.

At baseline, patients filled in the self-administered questionnaire, the Cincinnati Rating System (CRS; Noyes et al., 1984). This scale is numerical, and evaluates symptoms of pain (20 points), swelling (10 points), giving-way (20 points), and function (walking, climbing stairs, running and jumping/twisting; 50 points). The maximum score (no symptoms or signs) is 100 points.

Patients were further tested at baseline by the Stairs-Hopple test (Risberg et al., 1995). The patients jumped up and down 12 steps on one leg (each step 17-cm high). The better leg was tested first. Time was measured in tenths of seconds. The lowest value indicated best performance. Atrophy was measured (in centimeters) as thigh circumference 5 cm above the superior margin of the patella. The difference between

legs was noted. Pain immediately after testing and at rest the same evening was monitored by a 10-cm visual analogue scale (VAS). The same tests were carried out for the treatment group 6 weeks after inclusion and for both groups 5 months after inclusion. At 12 months after inclusion, only CRS was filled in. All types of analgesic medication in the last 7 days, including nonsteroidal anti-inflammatory drugs (NSAIDS), were noted at baseline, at 5 months, and at 12 months. Patients were also asked at 5 and 12 months whether they had attended physiotherapy treatment.

The physical tests at baseline were repeated by an independent examiner (S.F. see Acknowledgments), who was blinded to the patient's assignment to treatment group, 5 months after inclusion.

The study was approved by the Regional Committee for Medical Research Ethics and the Norwegian Data Inspectorate, and was supported by the Norwegian Research Council.

Statistics

Power calculations previous to beginning the study showed that in order to be able to disclose a difference of 15 in the CSR score with 80% certainty, a total number of 27 patients were needed in each group, given an estimation of standard deviation of 20, and $\alpha = 0.05$ and $\beta = 0.20$.

The CRS, regarded as the main outcome measure, was analyzed globally and by subscales. Differences between groups were tested by a *t* test for independent samples, and changes within a group were tested by a paired *t* test. Differences in categorical scales were tested by a Mann-Whitney test. Differences in proportions were tested by χ^2 tests. A significance level of at least 0.05 was adopted.

Background data are given with 95% confidence intervals (CI). Treatment efficacy is calculated as Number Necessary to Treat (NNT; Sackett et al., 1997).

RESULTS

A total of 75 patients were included in the study. Five patients left the study before the first follow-up: one in the acupuncture group underwent appendectomy, one in the control group moved out of the area, and three others in the same group did not show up for unknown reasons. The study thus consisted of 70 patients aged 18 to 45 (mean 31.0) years, 41 female and 29 male. Thirty-six (36) patients were randomly assigned to the treatment group, and thirty-four (34) to the control group.

Table 1 shows the demographic background data. Patients in the acupuncture group were younger (29 versus 33 years) and slimmer (BMI = 22.3 versus 24.0) than the controls. None of the differences can however be regarded as clinically important. There were no differences in demographic data when analyzed for gender.

Table 2 shows the results of the main outcome measure, the CRS. At completion of treatment there was already an increase in all scales. The score continued to increase more in this group than in the control group for all scales during the 12-month observation time, and is significantly different from the results in the control group at 12 months after inclusion (p =

TABLE 1. BACKGROUND DATA FOR SEVENTY PATIENTS WITH PATELLOFEMORAL PAIN SYNDROME

	Acupuncture group	*Control group*	*Difference*	*95% CI*
Number of patients	36	34		
Females (no.)	20	21		
Age (years)	29.0	33.4	4.4	0.57; 8.14
Body mass index	22.3	24.0	1.8	0.38; 3.12
Pain during activity (years)	6.4	6.8	0.4	−2.25; 2.98
Pain at rest (years)	4.5	4.2	0.3	−1.76; 2.33

Patients were randomly assigned either to acupuncture or no treatment (control group). Differences are given with 95% confidence intervals (CI).

TABLE 2. RESULTS BY CINCINNATI RATING SYSTEM (CRS)

	Group	Baseline	6 weeks	5 months	12 months
CRS, global score	Acupuncture	58.0	69.9	71.9	75.2*
	Control	56.1		66.1	61.7
CRS, symptoms	Acupuncture	26.8	33.3	34.8	37.1*
	Control	25.7		31.2	29.4
CRS, function	Acupuncture	31.2	36.3	37.0	38.0**
	Control	30.4		34.7	32.3
CRS, pain	Acupuncture	6.8	11.0	11.5	12.8***
	Control	7.5		9.8	9.4

*p = 0.005 versus control group.
**p = 0.02 versus control group.
***p = 0.006 versus control group.
Seventy (70) patients with patellofemoral pain syndrome either received acupuncture treatment or no treatment. All data are from the worst knee at time of inclusion in the study. Only the group that received acupuncture was evaluated at 6 weeks. Differences were tested by Mann-Whitney test.

0.005). Nine patients (four in the acupuncture group and five in the control group) did not return the CRS questionnaire.

A worst case scenario was calculated. When worst results at 12 months were substituted for missing data, the CRS score of the acupuncture group was 68.1 and the control group 54.4 (p = 0.03).

The CRS was further analyzed for clinical implications of the treatment. At baseline 2 of 36 in the acupuncture group and 1 of 34 in the control group had no pain at that point, or only occasional pain during strenuous activity. Among those treated, the proportion of patients free of pain increased somewhat after treatment (6/36), still more at 5 months (10/31 versus 6/32 in the control group), and half of the treated patients were free of pain 12 months after treatment (14/32 versus 3/29 in the control group, p = 0.007). Hence, 1 in 3 treated patients will be free of pain, or only have occasional pain during strenuous sport at 12 months due to the acupuncture treatment (NNT = 3.2, 95% CI, 2.1–6.9).

Function was similarly analyzed. At baseline, 5 of 36 in the acupuncture group, and 4 of 34 in the control group had slight or no limitation to activity. The proportions at 5 months were 10 of 31 versus 9 of 32. At 12 months after treatment, however, more than half of the patients who had received acupuncture treatment had no or slight limitation to activity (17/32 versus 7/29 in the control group, p = 0.04). Hence, 1 in 4 treated patients will obtain practically no limitation to activity at 12 months due to the acupuncture treatment (NNT = 3.7, 95% CI, 2.2–12.7).

At 5 months, the acupuncture group also reported significantly less pain than controls in the worst knee after the physical strain involved in the testing (Table 3). Likewise, there was for both groups a normalisation in the atrophy noted at the baseline (p = 0.01 for the control group). The reduction of atrophy was not significantly different in the two groups. When testing for dynamic strength as in Stairs-Hopple test however, no significant changes or differences were noted.

Thirty-three (33) of the thirty-six (36) in the acupuncture group, and thirty-two (32) of the thirty-four (34) in the control group were without analgesic medication the week prior to inclusion. At 5 months, the figures were 31 of 32 versus 30 of 31, and at 12 months, 28 of 32 versus 27 of 29. During the 12-month observation time, 3 of 32 in the acupuncture group and 2 of 29 in the control group attended physiotherapy treatment.

DISCUSSION

Vincent and Richardson (1986), in a review of acupuncture studies, made recommendations on how to conduct research in acupuncture:

(1) Any report must clearly specify the chosen acupuncture sites, number of sessions,

TABLE 3. RESULTS FOR SEVENTY PATIENTS WITH PATELLOFEMORAL PAIN SYNDROME

	Group	*Baseline*	*6 Weeks*	*5 Months*
Pain after testing, VAS	acupuncture	27.8	24.0	17.9*,**
	control	31.9		33.5
Pain in the evening, VAS	acupuncture	35.0	18.0	22.4
	control	30.7		32.5
Stair hopple test	acupuncture	18.3	16.9	17.1
	control	15.9		17.0
Atrophy, in cm	acupuncture	0.67	0.34	0.21
	control	0.66		0.11***

*p = 0.007 versus control group, t test, independent samples.
**p = 0.02 versus at baseline, paired t test.
***p = 0.01 versus at baseline, paired t test.
Patients either received acupuncture treatment or no treatment. All data are from the worst knee at time of inclusion in the study. Pain was measured by visual analogue scale (VAS) in millimeters (max 100 mm). Only the acupuncture group was evaluated at 6 weeks.

mode of stimulation, duration and frequency of stimulation, whether *de-qi* sensation was sought and point classification.

(2) Both subjective and objective measures are important assessments of therapeutic outcome.
(3) The durability of the change must be demonstrated by follow-up data.
(4) Double-blind treatment is methodologically preferable.

Our study adheres to the first three of these recommendations. Point one on the list describes classic Chinese acupucture, which was adopted in our study. Our main subjective effect measure was the CRS. It was originally developed and validated for assessing athletic performance after cruciate ligament damage (Noyes et al., 1984). The pain part (20 points) of the rating scale scores pain at rest or in activity ranging from daily activity to sports, thus valid for painful knee problems. The function part (50 points) scores problems with knee activities ranging from light recreational activities to such activities as running, jumping, and twisting. This is especially relevant for the patellofemoral pain syndrome, because the syndrome typically causes problems for young people engaged in these activities. Our main objective measure was the Stairs-Hopple test. This test correlates well with the Lysholm scale (Risberg et al., 1995) and to the CRS (Höher et al., 1995). Furthermore, our study has a 12 month follow-up (point 3), ensuring an evaluation of whether the observed effects were transitory.

The fourth recommendation favors a double-blind treatment. We conducted our study with blinded result evaluation. We had, however, no placebo group. The main reason was that there is no fully satisfying way of designing an acupuncture placebo group. This is especially true when using acupuncture in the treatment of a painful condition, because almost any needling of the skin may both induce an increased level of endorphins and stimulate the diffuse noxious inhibitory controls (DNIC) systems (LeBars et al., 1992; Lewith and Machin, 1983). We therefore decided to use an untreated group as control. Hence, we may not evaluate the effect of acupuncture per se, but only the effect for the patient of going to acupuncture treatment.

The knowledge of being treated may be a powerful placebo. Is the observed effect then partly a placebo effect? In that case we find the stable long-term effect interesting. McConnell (1986) reports that the decrease in symptoms from patellofemoral pain syndrome due to treatment in many cases is only temporary because many investigators have found at 12-month follow-up that only 30% of patients have remained symptom-free.

Not much is known of the mechanisms by which acupuncture works. Any needling of the skin may, however, raise endorphin levels or activate the DNIC (Andersson and Lundeberg, 1995; LeBars et al., 1992; Lewith and Machin, 1983), and repeated stimulation may induce prolonged increments. Less pain may motivate patients to increase their physical activity. Al-

though there is no documented treatment of choice for patellofemoral pain syndrome, most agree that strengthening the extensor muscles is beneficial for pain alleviation and function (LaBrier and O'Neill, 1993). Increased physical activity because of acupuncture-relieved pain may therefore be an explanation for our long-term results.

There has been some discussion on whether acupuncture may affect other physiologic parameters (Omura, 1997). Little is documented, and Myhal et al. (1981) found that acupuncture at least does not affect the vascularization of the knee, as evaluated by a radioactive ^{99m}Tc-albumin technique.

Local injury around the knee joint by trauma or overuse may change the threshold of receptors close to the joint (Coderre et al., 1993). Sensitized mechanoreceptors may act like nociceptors (Mense, 1993; Stokes and Young, 1984). Increased nociceptive sensation from areas close to the knee may result in a reflex inhibition of the quadriceps contraction and in muscle wasting (Leroux et al., 1995; Stokes and Young, 1984). This may lead to an extensor dysfunction due to a neurophysiologic motor control imbalance between the flexors and extensors and between the muscles in the quadriceps (Leoux et al., 1995; Voight and Wieder, 1991). This may contribute to continued patellofemoral pain syndrome (Voight and Wieder, 1991).

Pain in itself may play a role affecting the normal activity of the quadriceps (Arvidsson et al., 1986). Leroux et al. (1995) found significantly lower pain thresholds and nociceptive flexion response thresholds in patients with patellofemoral pain syndrome. Thomeé et al. (1995) found significantly reduced extensor strength in the more painful knee, and significantly reduced strength in patients with patellofemoral pain syndrome than in normal controls. This may imply a peripheral and central alteration of the nervous system due to a dysfunctional nociceptive system rather than continued tissue damage as possible causative factor of patellofemoral pain syndrome.

Acupuncture stimulates the nervous system through myelinated and nonmyelinated afferent fibers. The pain gate theory and the endorphin theory are often used to explain the effect on pain by acupuncture treatment (Andersson and Lundeberg, 1995). The acupuncture effect has also been explained through the DNIC (LeBars et al., 1992). Both pain and nociceptive reflexes in the flexor muscles of the knee may be affected by these mechanisms (Andersson and Lundeberg, 1995; LeBars et al., 1992; Lewith and Machin, 1983; Mense, 1993). If so, our study raises the question whether these mechanisms may normalize a dysfunctioning nociceptive system through acupuncture.

No other study has, to our knowledge, evaluated the effect of acupuncture treatment in patellofemoral pain syndrome. Indeed, there is limited evidence for any specific treatment (Arrol et al., 1997). Our study is one of the largest treatment studies on the syndrome, and it shows a clear, durable effect of acupuncture treatment in reducing pain and improving function for the patient.

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