Comparison Between Electro-Acupuncture and Hydrotherapy, Both in Combination With Patient Education and Patient Education Alone, on the Symptomatic Treatment of Osteoarthritis of the Hip

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Objectives: The aim of the study was to evaluate the therapeutic effect of electro-acupuncture (EA) and hydrotherapy, both in combination with patient education or with patient education alone, in the treatment of osteoarthritis in the hip.

Methods: Forty-five patients, aged 42–86 years, with radiographic changes consistent with osteoarthritis in the hip, pain related to motion, pain on load, and ache were chosen. They were randomly allocated to EA, hydrotherapy, both in combination with patient education, or patient education alone. Outcome measures were the disability rating index (DRI), global self-rating index (GSI), and visual analogue scale (VAS). Assessments were done before the intervention and immediately after the last treatment and 1, 3, and 6 months after the last treatment.

Results: Pain related to motion and pain on load was reduced up to 3 months after last the treatment in the hydrotherapy group and up to 6 months in the EA group. Ache during the day was significantly improved in both the EA and hydrotherapy group up to 3 months after the last treatment. Ache during the night was reduced in the hydrotherapy group up to 3 months after the last treatment and in the EA group up to 6 months after. Disability in functional activities was improved in EA and hydrotherapy groups up to 6 months after the last treatment. Quality of life was also improved in EA and hydrotherapy groups up to 3 months after the last treatment. There were no changes in the education group alone.

Discussion: In conclusion, EA and hydrotherapy, both in combination with patient education, induce long-lasting effects, shown by reduced pain and ache and by increased functional activity and quality of life, as demonstrated by differences in the pre- and post-treatment assessments.

Key Words: osteoarthritis, hip, electro-acupuncture, hydrotherapy, patient education

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One of the most common causatives of hip pain in elder persons is osteoarthritis.[1] The prevalence of radiographic verified osteoarthritis in the hip is 3% in the ages 55–64 year and 5–6% in the ages over 65 years.[2] Osteoarthritis in the hip is associated with pain, which is generally described as aching, use-related, at the end range of movement related to motion, and limited hip mobility with decreased functional ability.[3] It is characterized by local destruction of articular cartilage, leading to proliferation and remodeling of subchondral bone.[4] When joint damage is extensive, this pathology results in radiographic changes used to define it in clinical practice. Pain is the major symptom and the most common reason why people with osteoarthritis seek medical help. Accurate treatment is important and is aimed at pain relief to avoid development of chronic pain syndrome. Common treatment consists of pharmacological, such as nonsteroidal anti-inflammatory drug (NSAID) or COX-2–specific inhibitor, opiate analgesic and local cortisone injection, physiotherapy and exercise, hydrotherapy, acupuncture, and patient education.

Few studies exist concerning the efficacy of acupuncture in the treatment of hip osteoarthritis.[5,6] However, there are several clinical acupuncture studies on osteoarthritis in the knees and neck.[7–10] The research to date is inconclusive but promising. Basic scientific research suggests that acupuncture results in an activation of muscle afferents (mainly Aδ- and possibly C-fibers) and relieves pain through modulation of spinal reflexes[11] and through modulation of the release of endogenous opioids in the central nervous system.[12–14] Low-frequency electro-acupuncture (EA) (1–4 Hz) stimulation with needles probably excites a group of receptors found in muscles, denoted ergoreceptors,[15,16] which are physiologically activated during muscular contractions. There is a proposed link be-

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tween low-frequency EA and muscle exercise supported by studies showing that both events may result in the release of endogenous opioids, and there is evidence that the hypothalamic ß-endorphinergic system has a central role in mediating the pain-relieving effect of EA.[12–14,17] Sandküler has demonstrated a long-term depression in the dorsal horn by low-frequency stimulation of Aδ-fibers,[18–20] which may underlie segmental pain inhibition.

Exercise therapy aims to reduce pain and disability, probably by activation of physiological processes similar to those resulting from low-frequency EA. This is achieved through improvement of muscle strength, joint stability, range of motion, and aerobic capacity. The use of exercise in warm water is promoted because of its physical properties, such as buoyancy and temperature. The weight-relieving property of water immersion allows easier movement with less pain, which may also be attributed to the warmth of the water. Few studies exist about the efficacy of hydrotherapy in the treatment of hip osteoarthrosis, but there is some indication that hydrotherapy reduces pain and disability.[21,22] In our knowledge, there are no other previous controlled trials that have compared the therapeutic effect of hydrotherapy and EA, both in combination with patient education.

Patient education is a cornerstone of the treatment of osteoarthritis. Data suggest that group patient education for people with osteoarthritis improves health status and is cost effective.[23,24] It may also help to extend the time before a total hip replacement is necessary.[25]

Despite inconsistencies in the efficacy of these interventions, the current treatment has increased in popularity. Since there is a lack of evidence to support the effect of low frequency EA and hydrotherapy, there is a need for evaluation on the effect of these methods in the treatment of hip pain caused by osteoarthritis.

The main objective of the present study was to evaluate the therapeutic effect of EA and hydrotherapy, both in combination with patient education, or patient education alone. This was done by measuring changes in pain related to motion and pain on load, ache during day and night, functional ability, and quality of life in patients with radiographically verified osteoarthritis in the hip joint.

MATERIAL AND METHODS

The study was a prospective, randomized, controlled clinical trial performed at the physiotherapy clinic at Krokslätts Vårdcentral in Mölndal, Sweden, from 1997 to 1999.

The local ethics committee in Göteborg, Sweden, approved the study, and before commencement, written informed consent was obtained from all participants.

Participants

Forty-five patients were consequently preselected by orthopedics at Sahlgrenska University Hospital, Mölndal, and by general practitioners at the outpatient department in Mölndal, Sweden. All patients were on a waiting list for total hip arthroplasty. The main inclusion criteria were radiographic changes consistent with osteoarthritis in the hip and pain related to motion and/or pain on load and/or ache during rest. Patients with a pacemaker, hepatitis B, epilepsy, or rheumatoid diseases were excluded. Patients who were eligible and willing to participate in the study were given written information about study design, randomization, assessments, and the different interventions

Randomization

Participants were randomly allocated to EA in combination with patient education (n = 15) or hydrotherapy in combination with patient education (n = 15) or patient education alone (n = 15) as a control by using sealed, unlabeled envelopes. The term "EA group" is used hereafter and refers to EA in combination with patient education, and the term "hydrotherapy group" refers to hydrotherapy in combination with patient education. Participants were informed that they could discontinue the study at any time.

Treatment

Patients were treated 10 times during 5 weeks, 2 times per week. Each treatment lasted for 30 minutes. All treatments were performed by 2 experienced physiotherapists, CK-S and KJ.

Electro-Acupuncture (EA)

The patient was positioned on the side, lying with their affected hip uppermost. The acupuncture needles were placed locally in the most painful area of the hip and distally in points according to the segmental innervation of the hip joint (lumbar 3–5) (Table 1). Locally in the pain area, four of the following points were selected: BL 54, 36, GB 29, 30, 31, and ST 31. The distal points were always the same, GB 34 and BL 60 ipsilateral, both in the same segmental innervation as the hip joint. The needles (Hegu; Hegu AB, Landsbro, Sweden) were made of stainless steel for single use and were inserted intramuscularly to a depth of 15–35 mm. Needle sizes were 0.32 × 30 mm and 0.40 × 50 mm. They were then rotated manually to evoke needle sensation, reflecting activation of muscle–nerve afferents (Aδ- and possibly C-fibers), in total 4 times during each treatment.[26,27] All needles were attached to an electrical stimulator (ACUS I; Cefar, Lund, Sweden) and stimulated with continuous square wave pulses with alternating polarity. The frequency used was low burst frequency of 2 Hz (each pulse has a duration of 180 microseconds, a burst length of 0.1 seconds, and a burst frequency of 80 Hz). The intensity was sufficient to cause non-painful local muscular contractions and was optimized for each patient in an attempt to activate both the segmental pain control systems and the central descending pain

TABLE 1. Acupuncture Points—Their Anatomical Position and Their Innervation

Points	Segmental Innervation	Localization
BL 36	N. gluteus inferior (L5, S1–2)	In m. gluteus maximus, in the middle of the dorsal side of the tight, level of gluteal fold
BL 54	N. gluteus inferior (L5, S1–2)	In m. gluteus maximus, 3 cun lateral to the midline, level with hiatus sacralis
BL 60	N. suralis (L5, S1–S2)	In fibrous tissue, in the depression between the most prominent point of the lateral malleolus and the achilles tendon
GB 29	N. gluteus superior (L4–5, S1)	In m. tensor fascia latae, in the middle of a line between SIAS and the most prominent point of trochanter major
GB 30	Nn. gluteus inferior (L5, S1), obturatorius internus (L4–5, S1)	In mm. gluteus maximus, gemellus superior and piriformis, on a line between hiatus sacralis and the most prominent point of trochanter major, at the junction of the lateral and middle third of the line
GB 31	Nn. femoralis (L2–4), gluteus superior (L4–5, S1)	In mm. tensor fascia latae and vastus lateralis, in the middle of the lateral side of the thight, 7 cun proximal to the lateral joint of the knee
GB 34	N. peroneus profundus (L5, S1)	In. m. extensor digitorum longus, in the depresson ventral and distal to caput fibulae
ST 31	N. femoralis (L2–4)	In m. rectus femoris, 3 cun caudal to SIAS, lateral to m. sartorius

BL, bladder; GB, gall bladder; ST, stomach; cun, the Chinese "body inch", 1 thumb-width, distal phalange; SIAS, spina iliaca anterior superior.

inhibitory systems, including central ß-endorphinergic systems.

Hydrotherapy

Hydrotherapy was performed in small groups, 1–3 in each, in an Arjo pool with 34°C warm water. The program consisted of warming up, mobility, and strengthening exercises for the muscles around the pelvis and stretching exercises.

Patient Education

All participants went through the patient education. The patient education consisted of 2 group meetings of 2 hours each. They were taught about hip anatomy and the disease process. Instructions and advice about load–unload, activity–inactivity, and pain relief, as well as information about total hip arthroplasty surgery. They were also given information about aid facilities and instructions for a program of home exercise, which included 10 exercises, aiming to improve the muscle strength, joint stability, and range of motion in the hip. They were taught to train once per day with intensity below pain.

Assessments

The EA and hydrotherapy groups were assessed before the intervention and immediately after the last treatment. Follow-up included 1 assessment at 1, 3, and 6 months after the last treatment. The control group was assessed at the same point of time except from the time immediately after the last treatment. The same physiotherapists who gave the treatment (CK-S and KJ) made all assessments.

Outcome Measures

Outcome measures were determined by a functional index, called the disability rating index (DRI),[28] a quality-of-life status called the global self-rating index (GSI),[29] and, for pain, the visual analogue scale (VAS).[30]

DRI includes 12 functions for rating the degree of disability in functional activities in daily life, eg, walking upstairs/downstairs. Each function consists of a 100 mm line oriented vertically on a paper. The sum of the 12 ratings divided by 12 gives the index value.

GSI consists of 10 yes or no questions concerning quality of life. Each answer gives a value that is summarized. The maximum value is 10.

VAS was used for pain rating. Each VAS consisted of a 100-mm line oriented vertically on a paper with 3 different questions with 2 endpoints: *no pain* and *unbearable pain*. The questions asked were: "Do you have any pain related to motion and/or pain on load now?" "Do you have any ache during the day?" "Do you have any ache during the night?"

Statistics

All statistical analyses were carried out using Statistica 4.1 for Macintosh. Assessment of the rating scales VAS, DRI, and GSI was ordered into categorical levels. For that reason, data were statistically evaluated by non-parametric methods. The primary aim was to evaluate the therapeutic effect of each

specific treatment. The time point before intervention was compared with immediately after the last treatment and 1 month, 3 months, and 6 months after the last treatment. Statistically significant changes over time, within each group, were analyzed with the Wilcoxon matched pairs test. The secondary aim was to compare differences between the three interventions. Significance analyses for comparisons between different interventions were made with Kruskal–Wallis calculations. If statistically significant results were shown by Kruskal–Wallis, then the 2-sample Mann–Whitney *U* test was used to identify where the differences lie. *P* values less than 0.05 were considered significant.

RESULTS

Of the 45 included patients were 27 women and 18 men, aged 42–86 years. The "EA group" consisted of 10 women and 5 men, aged between 49 and 86 years (mean 65.7 years), the "hydrotherapy group" consisted of 8 women and 7 men, aged between 49 and 83 years (mean 70.3 years), and the "control group" that received only patient education consisted of 9 women and 6 men, aged between 42 and 86 years (mean 65.5 years). The duration of their symptoms was between 4 months to 15 years. Figure 1 shows the progress and withdrawal of patients throughout the study.

Table 2 shows the median and interquartile range (25th and 75th percentiles) for each measurement on the VAS.

Pain Related to Motion and Pain on Load (VAS)

Pain related to motion and pain on load improved significantly in patients who received EA compared before the treatment period (baseline) with directly after the last treatment ($P < 0.05$), 3 months after ($P < 0.05$), and 6 months after ($P < 0.05$) the last treatment. The hydrotherapy group improved significantly compared with baseline at 3 months after the last treatment ($P < 0.05$). There were no improvements in the group who received education alone, and there were no differences between all 3 intervention groups at any time.

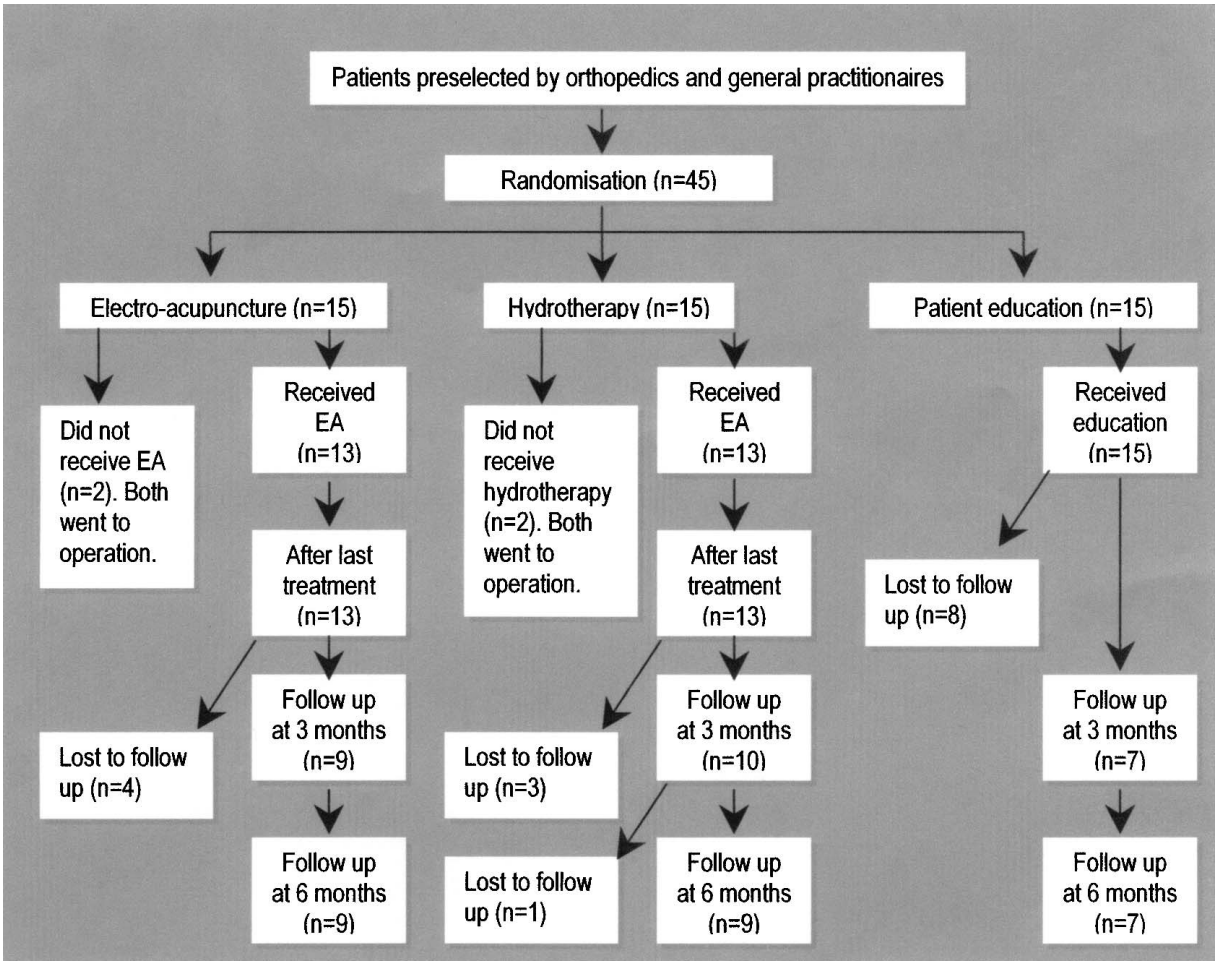

FIGURE 1. Progress and withdrawal of patients throughout the study.

TABLE 2. Median and Interquartile Range (25th, 75th Percentiles) for Each VAS Measurement of Pain Related to Motion and Pain on Load, of Resting Ache During Day and Night, Respectively, Before Intervention (= Baseline) After 10 Treatments, and 1, 3, and 6 Months After the Last Treatment in the Electro-Acupuncture (EA), Hydrotherapy, and Control Group, Respectively

Questions VAS (0–100)	Baseline, Before Intervention	After 10 Treatments	1 Month After Last Treatment	3 Months After Last Treatment	6 Months After Last Treatment
Pain related to motion and pain on load					
EA	37 (29, 63)	22 (11, 43)*	28 (9, 50)	24 (4.5, 46.5)*	17 (1, 79)*
Hydrotherapy	55 (32, 64)	35 (23, 54)	30 (18, 59)	25.5 (22, 38)*	28 (18, 70)
Control	56 (46, 70)		48.5 (26, 66)	48.5 (35, 55)	59 (51, 69)
Ache during day					
EA	21 (6, 35)	4 (3, 23)*	4 (3, 51)*	5.5 (2, 25)*	14 (1, 73)
Hydrotherapy	26 (5, 63)	15 (3, 24)*	7.5 (3, 24)**	7 (5, 18)*	11 (7, 50)
Control	28 (18, 49)		41.5 (20, 57)	28 (10, 45)	16 (11, 50)
Ache during night					
EA	27 (12, 52)	5 (2, 22)**	12 (3, 64)	11.5 (2, 37)	6 (2, 76)*
Hydrotherapy	42 (13, 70)	11 (2, 28)**	10 (2, 24)**	23 (5, 29)	18 (5, 52)
Control	29 (20, 62)		41.5 (20, 57)	36 (11, 60)	39 (15, 52)

*$P < 0.05$, **$P < 0.01$, within each group when baseline is compared with after 10th treatment and after 1, 3, and 6 months, respectively.

Ache During the Day (VAS)

Ache during the day was significantly reduced in patients who received EA and hydrotherapy compared with baseline directly after the last treatment (both $P < 0.05$), 1 month after ($P < 0.05$ and $P < 0.01$ respectively), and 3 months after (both $P < 0.05$) the last treatment. There were no improvements in the group who received education alone. One month after the last treatment, the reduction of ache during the day was significantly greater in the hydrotherapy group ($P < 0.01$) compared with only education.

Ache During the Night (VAS)

Ache during the night was significantly reduced in patients who received EA and hydrotherapy compared with baseline directly after the last treatment (both $P < 0.01$). One month after, the hydrotherapy group ($P < 0.01$), but not the EA group, significantly improved. Six months after the last treatment, the EA group ($P < 0.05$), but not the hydrotherapy group, significantly improved. There were no improvements in the group that received education alone. One month after the last treatment, the reduction of ache during the night was significantly greater in the hydrotherapy group ($P < 0.01$) compared with only education.

Table 3 shows the median and interquartile range (25th and 75th percentiles) for each measurement on the DRI and GSI.

DRI—Functional Index

DRI was significantly reduced in patients who received hydrotherapy compared with baseline directly after the last

TABLE 3. Median and Interquartile Range (25th, 75th Percentiles) for Each DRI and GSI Measurements, Before Intervention (= Baseline), After 10 Treatments, and 1 Month, 3 Months, and 6 Months After the Last Treatment in the Electro-Acupuncture (EA), Hydrotherapy, and Control Group, Respectively

	Baseline—Before Intervention	After 10 Treatments	1 Month After Last Treatment	3 Months After Last Treatment	6 Months After Last Treatment
DRI					
EA	36 (27, 50)	28 (25, 47)	35 (15, 47)	33.5 (11, 48.5)	25 (20, 89)*
Hydrotherapy	45 (34, 47)	31 (20, 41)*	23.5 (20.5, 30)*	26.5 (19, 44)*	34 (15, 47)
Control	43 (36, 57)		45 (36, 51.5)	51.5 (45, 61)	51 (30, 65)*
GSI					
EA	2.5 (1.25, 3.5)	0.25 (0, 0.75)**	0.75 (0, 1)*	0.5 (0, 3.5)*	0.25 (0, 3.5)
Hydrotherapy	2.5 (0.25, 3.75)	0.25 (0, 1.25)*	0.37 (0, 1.12)*	1 (0.5, 1.5)*	1 (0.25, 2.5)
Control	3.75 (3, 4.25)		3 (1, 3.6)	3 (0.5, 4)	3 (0.5, 4)

*$P < 0.05$, **$P < 0.01$, within each group when baseline is compared with after 10th treatment and after 1, 3, and 6 months, respectively.

treatment ($P < 0.05$), 1 month after ($P < 0.05$), and 3 months after ($P < 0.05$). Six months after the last treatment, the EA group ($P < 0.05$), but not the hydrotherapy group, significantly improved. DRI was significantly increased in patients who received only education compared with baseline 6 months after the last treatment ($P < 0.05$).

One month after the last treatment, the DRI significantly decreased in the hydrotherapy group ($P < 0.01$) compared with only education. Three months after the last treatment, the DRI decreased significantly more in both the EA group and the hydrotherapy group ($P < 0.01$ and $P < 0.05$, respectively) compared with education alone.

GSI—Quality of Life

GSI was significantly reduced in patients who received EA and hydrotherapy compared with baseline directly after ($P < 0.01$ and $P < 0.05$, respectively), 1 month after (both $P < 0.05$), and 3 months after (both $P < 0.05$). There was no improvement in GSI in patients who received only education at all time points.

One month after the last treatment, the reduction in GSI was significantly greater in both the EA group and the hydrotherapy group ($P < 0.01$ and $P < 0.05$, respectively) compared with education alone. Three months after, the reduction was significantly greater only in the EA group ($P < 0.05$) compared with education alone.

DISCUSSION

The main outcome of the present study was that EA and hydrotherapy, both in combination with patient education, offer clear advantages for patients with hip pain caused by osteoarthritis over patient education alone, as shown by reduced pain, increased function, and increased quality of life.

Pain related to motion and pain on load was reduced up to 3 months after the last treatments in the hydrotherapy group and up to 6 months in the EA group. Ache during the day was significantly improved in both the EA and hydrotherapy group up to 3 months after the last treatment. Ache during the night was reduced in the hydrotherapy group up to 3 months after the last treatment and in the EA group up to 6 months after. The results clearly indicate that both EA and hydrotherapy induce good pain relief for patients with hip pain caused by osteoarthritis. It also indicates that both EA and hydrotherapy induce long-term effects. These results are in line with previous reports.[5,6,31]

Disability in functional activities in daily life was improved in EA and hydrotherapy groups up to 6 months after the last treatment. In the control group, disability in functional activities deteriorated 6 months after the last treatment. Quality of life was also improved in EA and hydrotherapy groups up to 3 months after the last treatment.

The advantage of hydrotherapy is that it can be given as a group therapy, with psychosocial and sociobehavioral benefits. However, many patients do not tolerate warm water for different reasons, eg, infections. Another disadvantage of hydrotherapy is that it is an extremely expensive method. Acupuncture is well accepted by most patients, but it does not have the beneficial group effect.

The mechanisms behind the beneficial effect of EA and hydrotherapy is most likely explained by activation of endogenous pain inhibitory mechanisms at both central and segmental levels previously described in the introduction.[32] Reduced pain will automatically improve functional activities. Many patients experienced changes in mood, such as relaxation and improved well being, which possibly explains the increased quality of life after EA or hydrotherapy treatment. This is probably the result of effects on the central hormonal system, including the release of oxytocin.[33,34]

Patient education has previously been reported to improve health status, to be cost effective, and to give pain relief.[23,24] We were not able to confirm this in the way that patient education was given in the present study. The patient education used in the present study was a modification of an original education program that consisted of 4 group meetings. The reduction in the number of meetings may be one reason for the lack of effect by patient education. Another reason might be that patients in the education group received less social support compared with patients in both the EA and hydrotherapy groups. It has previously been shown that patients with osteoarthritis who received bi-weekly telephone calls improved significantly both regarding physical disability and pain relief.[35] In the present study, patients in both the EA group but especially in the hydrotherapy group received much more social support during their treatment period.

There are limitations in the present study, such as sample size and control situations. For this reason, we are not able to determine any specific treatment effects. Power calculations showed that a number of 86 patients would be needed in each group to detect statistically significant differences ($P < 0.05$) in pain ratings. Furthermore, the physiotherapists who assessed the patients were the same as those providing treatment. Of course, blinding of the assessors would strengthen the study by reducing examiner bias. Despite methodological limitations, there are many indications that both EA and hydrotherapy in combination with patient education is superior to patient education alone. However, further randomized, controlled trials need to be undertaken.

In conclusion, EA and hydrotherapy, both in combination with patient education, induce long-lasting effects, demonstrated by reduced pain and ache and by increased functional activity and quality of life, as shown by differences in the pre- and post-intervention assessments. The pain relief was more long lasting, up to 6 months, in the EA group. Patient education alone does not improve any variable in the present study.

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