

A specific Electrotherapy Technique in the Treatment of Osteoarthritis of the Knee: Three Case Reports

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Arthritis has been estimated to affect 40 million people in the United States, with costs to society of \$ 65 billion reported in 1992.¹ Osteoarthritis is the most prevalent form of arthritis and is a major cause of disability in the elderly population.² Patients report stiffness, instability, limited range of motion, and reduced function, with the paramount symptom being pain. The most common site of osteoarthritis is in the knee joint.³

The contribution of knee pain and knee osteoarthritis to reduced quality of life and general lower limb disability has been found in several community-based investigations.⁴

Medical management guidelines for the treatment of osteoarthritis include weight loss, physical and occupational therapy, exercise (particularly aerobic), pharmacologic support, and patient education concerning the disorder.⁵ Analgesics such as acetaminophen, non steroidal anti-inflammatory drugs, and topical analgesics are often used to control pain symptoms. Osteoarthritis management remains primarily ineffective, and many pharmacologics that are used to treat the condition can potentially produce serious side effects, particularly after chronic use.⁶

Electrical stimulation has been shown to be better than other physiotherapy modalities for the treatment of osteoarthritis yet benefits are transient. Lewis et al⁷ found that electrical stimulation was effective for chronic osteoarthritis of the knee, but the effectiveness was not greater than that of placebo. In a clinical trial using a short course of electrical stimulation, Zizic and colleagues⁸ found that electrical stimulation for osteoarthritis of the knee showed improvements in morning stiffness and pain, yet no improvement in walking time. Ordog⁹ has shown that electrical stimulation is equal to nonsteroidal anti-inflammatory drugs as a pain reliever of acute traumatic pain, and recommends that deleterious, unwanted effects of drug therapy be avoided using electrical stimulation.

The treatment regimen was based on an electrical stimulation technique called "Horizontal[®] therapy." This therapy is performed with a multifunctional electrical stimulation unit, the HakoMed unit. The electrodes used with this unit are not traditional 2- to 4 inch pads; instead, a moistened, foam-like material surrounds the entire knee. The electrical stimulation entails an interferential-type current with one signal modulating at a lower frequency and another signal sustaining an ultra-high frequency from 1000 to

30,000 Hz. The amplitude of the current can be modulated like traditional electrical stimulation units. In this particular protocol, the frequency was modulated between 4000 and 12,000 Hz for 45 minutes. To obtain physiologic effect, the amplitude was modulated to match the increasing and decreasing frequency. In this trial, a sensory level stimulus was used.

Horizontal[®] Therapy was given to 3 knee osteoarthritis patients at our facility. Patients were confirmed to have osteoarthritis of the knee through history, physical examination, and diagnostic radiographs, with rankings determined by the Kellgren and Lawrence scale.¹⁰ To measure the response to this treatment in an objective fashion, we asked patients to complete outcome measures before and after treatment, which included current pain, lease pain, most pain (all on a 0-10 scale), mood (on a 10-0 scale), a 6-minute walk (the distance walked in 6 minutes), and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)¹¹ – a valid, multi-dimensional self-report scale that assesses pain, stiffness, and physical function for osteoarthritis of the knee. The WOMAC has been shown to be more responsive than the Lequesne index¹² for assessment of lower-extremity osteoarthritis.¹³ Outcomes were also collected during 4 weeks following the one-time treatment. These outcomes were chosen to objectively track treatment benefits in terms of pain, function, and mood.

Case 1

SF, a 58-year-old woman, presented with bilateral knee pain that began insidiously 1 year earlier and was greater on the right. The patient denied any history of trauma or sensory deficit to the area. The pain began as intermittent and gradually became constant. Pain was provoked by an increase in activities and stiffness was brought on by a lack of activity such as prolonged sitting. SF noted a family history of osteoarthritis. She was taking 600mg of ibuprofen when necessary for pain relief. Palpation provoked the chief complaint at the medial right knee, range of motion was full, and no orthopedic test were positive. Right knee radiographs revealed medial tibiofemoral joint degeneration and degeneration of the patellofemoral joint with significant decrease in the medial joint space. Prior to this trial, SF had been diagnosed with right-knee osteoarthritis and was given treatments of Russian electrical stimulation. She discontinued treatments 7 months prior to the study.

SF was treated with the HakoMed electrical stimulation unit, as described above. She showed improvement in current pain and mood after treatment versus before treatment (pain on a 0-10 scale was 3 of 10 versus 1 of 10; mood on a 10-0 scale was 5 of 10 versus 2 of 10) and improvement continued through week 2 (pain, 0 of 10; mood, 0 of 10). Outcomes in week 4 declined slightly compared to week 2, but all outcomes in week 4 were improved compared to those before treatment (pain, 2 of 10 at 4

weeks after treatment versus 3 of 10 before treatment; mood, 1 of 10 at 4 weeks after treatment versus 5 of 10 before treatment). Six minutes walk distance improved from 1190 feet before treatment to 1244 feet after treatment, and to 1345 feet 4 weeks after treatment. Scores on the WOMAC index improved from 56 of 96 before treatment to 67 of 96 four weeks after treatment. This patient responded very well to the treatment based on a reduction in pain, an improved in walk distance, WOMAC scores, and especially in mood scores. A good prognosis could be foreseen with continued treatment.

SF responded best to the treatment. Most important in her subjective response to treatment was that her least pain was 0 of 10. This patient was very disappointed that the treatment did not continue. She did not return for further treatment.

Case 2

DK, a 69-year-old woman, presented with left knee pain that was of insidious onset and had begun months earlier. The patient stated that she recently felt her knee "give out." During this episode the pain was sharp, but unusually it was dull and achy. Palpation and inspection revealed medial left knee pain with mild surrounding edema. Motor strengths were +3/+5 for left anterior, medial and posterior thigh muscle groups. Range of motion was decreased by 20%. McMurray's test for internal derangement was positive, and the chief complaint was elicited with valgus and varus stress as well as anterior and posterior drawer tests. No sensory deficits or changes were found. Radiographs revealed osteophyte formation on the superior pole of the patella, sharpening of the tibial eminences, and a decrease in the medial tibio-femoral joint space.

The patient was diagnosed with left-knee osteoarthritis and given weekly treatments of ultrasound or diathermy with mobilization and cryotherapy. The patient was also given home stretches for the hamstrings and quadriceps.

The patient discontinued these treatments to participate in this trial.

The patient was treated with the HakoMed electrical stimulation unit. DK's pain scores improved after treatment compared to before treatment, from 3 of 10 to 1 of 10; mood improvement from 5 of 10 to 3 of 10 (the lower score was an improvement) and continued to improve 1 week after treatment. DK's least pain on a 0-to-10 scale improved from 3 of 10 before treatment to 0 of 10 one week after treatment. Most pain improved on a 0-to-10 scaled from 6 of 10 to 3 of 10. DK showed a worsening of outcomes 2 weeks after treatment, but all outcomes (except for interference with activities of daily living) 4 weeks after treatment were better compared to those before treatment. In addition, WOMAC scores improved from 43 of 96 before treatment to 59 of 96 four weeks after treatment. DK responded well to the one-time treatment. She returned to our health center shortly after the trial and an evaluation revealed no edema and decrease tenderness on palpation. Based on improved scores and elimination of edema after 4 weeks, DK would most like respond well to a full course of this therapy.

Case 3

KD, a 45-year-old woman, first presented with left knee pain. She denied recent trauma, but noted that she had fractured her patella 15 years earlier and had persistent pain since that time. The pain in the left knee was described as being sharp to dull and was 8 of 10 at worst and 4 of 10 at best on a 1-to-10 pain scale. The patient's symptoms were exacerbated by cold weather. Palpable medial left knee pain and mild edema existed in the entire left knee. Range of motion was decreased by 15%. Motor strengths were +4/+5 for left anterior, medial and posterior thigh muscle groups. Clark's test for patellar derangement was positive on the left, with chief complaint being elicited with valgus stress and anterior drawer test. No sensory deficits or changes were found. Two-view left patella, the distal femur, and tibial plateau. A diagnosis of left knee osteoarthritis was given. For 3 months leading up to this study, the patient received biweekly treatments of ultrasound, cryotherapy, and proprioceptive neuromuscular facilitation, which stretched the hamstrings and quadriceps.

The patient discontinued these treatments to participate in this trial.

The patient was treated with the HakoMed electrical stimulation unit, KD's pain scores improved from 7 of 10 to 4 of 10 before and after treatment, but returned to 7 of 10 one week after treatment and ended at 7 of 10 four weeks after treatment. KD's most pain score modulated between 7 of 10 and 8 of 10 throughout the trial. KD's least pain score modulated between 4 of 10 and 5 of 10 during the trial. KD's interference with activities of daily living score worsened from 6 of 10 before treatment to 8 of 10 one week after treatment, and improved to 5 of 10 two and 4 weeks after treatment. KD's mood score was at 7 of 10 before treatment, 4 of 10 after treatment, 6 of 10 one week after treatment, and 4 of 10 two and 4 weeks after treatment. KD's 6-minute walk distances improved from 882 feet to 1010 feet after treatment, and again to 1090 feet 4 weeks after treatment. Consistent with KD's improvement in function, her WOMAC score improved from 21 of 96 to 37 of 96. Although KD's 6-minute walk distances and WOMAC score improved throughout the study, her pain scores did not. KD came into the study with a high pain score (7 of 10) that improved after

treatment, but reverted back 1 week after treatment. It is impossible to determine whether a longer treatment period would produce a more stable improvement for this patient.

Despite improvements in functional outcomes (WOMAC and 6-minute walk), DK saw no real improvement in her subjective description of knee pain or in the objective and palpable pain during the 4 weeks of the study and beyond.

After the HakoMed treatment, the patient returned to our health center and received the same diathermy treatment she had previously been receiving.

Discussion

Many one-time treatment modalities can reduce pain in the short term and increase function in patients with osteoarthritis, whether they be physiotherapy modalities or prescription drugs for pain or inflammation. This particular treatment modality was no different – in all cases there was immediate benefit in terms of pain, function, and mood. This is consistent with previous work showing good short-term relief of various conditions with horizontal therapy with the HakoMed electrical stimulation unit.¹⁴ Therefore,

an improvement in outcomes after treatment versus before treatment was expected.

Unlike previously mentioned studies showing the palliative relief of osteoarthritis symptoms with the use of such modalities this investigation showed benefits beyond the short term.²⁸ Although many of the outcome measure worsened in week 1 and 2, there was still overall improvement in pain and mood scores before treatment versus 4 weeks after treatment. Improvements in patient function were reflected both in the 6-minute walk distance and in the WOMAC scores before treatment versus 4 weeks after treatment.

SF and DK had lower pain scores before treatment than did KD, and responded better to treatment than KD. Because KD experienced a minimal short-term gain, it is unknown whether more treatment would be helpful or not. SF and DK responded well to the treatment. Further treatments would likely help them sustain pain-free states, as they both responded that their least pain was 0 on a post-treatment 0-to-10 scale. The measure of least pain is significant in the area of osteoarthritis, because this disorder often leaves patients in moderate yet constant pain, unlike other arthritis conditions that have severe exacerbation juxtaposed with periods that are relatively symptom free. Further treatments would also be needed to determine whether SF and DK could achieve long-term pain-free states. SF did not return to our health center for further treatments. She was very excited about the pain-free state she had achieved from one treatment. Along with her satisfaction, SF voiced frustration with the fact that further treatment was not possible within the study design (even though it was made clear that this was a one-time trial) and that her symptoms were returning.

High-frequency (1000 Hz) electrical stimulation has been shown to modulate cell fibroblast production and cell repair in neonatal bovine cells.²⁹ Previous studies on classic transcutaneous electrical nerve stimulation have shown temporary benefits from 4 to 6 weeks of treatment. These studies have not shown any long term benefit. The present study implies that benefits were gained beyond the expected short-term gains.

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