I. POLICY

Electrical stimulation (e.g. BioniCare Bio-1000™) is considered **investigational** for the treatment of osteoarthritis, rheumatoid arthritis or any other condition as there is insufficient evidence to support a conclusion concerning the health outcomes or benefits associated with this procedure.

**Cross-references:**
- MP-6.020 Transcutaneous Electrical Nerve Stimulation
- MP-6.045 Sympathetic Therapy for the Treatment of Pain
- MP-6.046 Threshold Electrical Stimulation as a Treatment of Motor Disorders
- MP-6.047 Interferential Stimulation for Treatment of Pain
- MP-6.049 H-Wave Electrical Stimulation
- MP-6.050 Percutaneous Electrical Nerve Stimulation (PENS) and Percutaneous Neuromodulation Therapy
- MP-6.051 Neuromuscular and Functional Neuromuscular Electrical Stimulation

II. PRODUCT VARIATIONS

This policy is applicable to all programs and products administered by Capital BlueCross unless otherwise indicated below.

FEP PPO*

* Refer to FEP Medical Policy Manual MP-1.01.27 Electrical Stimulation for the Treatment of Arthritis. The FEP Medical Policy manual can be found at: [www.fepblue.org](http://www.fepblue.org)
III. DESCRIPTION/BACKGROUND

Electrical stimulation is being investigated to improve functional status and relieve pain related to OA and RA unresponsive to other standard therapies. Noninvasive electrical stimulators generate a weak electrical current within the target site using pulsed electromagnetic fields, capacitive coupling, or combined magnetic fields. In capacitive coupling, small skin pads/electrodes are placed on either side of the knee or wrist. Electrical stimulation is provided by an electronic device that noninvasively delivers a subsensory low-voltage, monophasic electrical field to the target site of pain. Pulsed electromagnetic fields are delivered via treatment coils that are placed over the skin. Combined magnetic fields deliver a time-varying magnetic field by superimposing the time-varying magnetic field onto an additional static magnetic field.

In basic research studies, pulsed electrical stimulation has been shown to alter chondrocyte-related gene expression in vitro and to have regenerative effects in animal models of cartilage injury. Therefore, pulsed electrical stimulation is proposed to be similar to bone stimulator therapy for fracture nonunion.

Regulatory Status

The BioniCare Bio-1000™ stimulator is a device that has received FDA 510(k) marketing clearances to deliver pulsed electrical stimulation for the treatment of OA of the knee and RA of the hand. FDA gave the BioniCare Bio-1000™ clearance after finding it to be substantially equivalent to transcutaneous electrical nerve stimulation (TENS) devices. The BioniCare system consists of an electronic stimulator device with electrical leads that are placed over the affected area and held in place with a lightweight, flexible wrap and Velcro fasteners. The battery-powered device delivers small pulsed electrical currents of 0.0 to 12.0 V output. It is recommended that the device be worn for at least 6 hours per day, and patients are reported to often wear the device while sleeping. It is proposed that the device treats the underlying cause of the disease by stimulating the joint tissue and improving the overall health of the joint and that it provides a slow-acting, but longer-lasting improvement in symptoms.

The FDA’s 510(k) summaries specify the BioniCare Stimulator, Model Bio-1000™ is indicated for use as an adjunctive therapy in reducing the level of pain and:

- symptoms associated with osteoarthritis of the knee and for overall improvement of the knee as assessed by the physician’s global evaluation (clinical studies); and
- stiffness associated with pain from rheumatoid arthritis of the hand.

The BioniCare system is contraindicated in patients with demand-type pacemakers and may interfere with other electronic devices.

The OrthoCor™ Active Knee System (OrthoCor Medical) uses pulsed electromagnetic field energy at a radiofrequency of 27.12 MHz to treat pain. In 2009, the OrthoCor Knee System was cleared for marketing by FDA through the 510(k) process and is classified as a shortwave
diathermy device for use other than applying therapeutic deep heat (K091996, K092044). It is indicated for adjunctive use in the palliative treatment of postoperative pain and edema in superficial soft tissue and for the treatment of muscle and joint aches and pain associated with overexertion, strains, sprains, and arthritis. The system includes single-use packs (pods) that deliver hot or cold and are supplied in packets of 15. The predicate devices are the OrthoCor (K091640) and Ivivi Torino II™ (K070541).

In 2008, the SofPulse™ (also called Torino II, 912-M10, and Roma3™; Ivivi Health Sciences – renamed Amp Orthopedics) was cleared for marketing by FDA through the 510(k) process as a short-wave diathermy device that applies electromagnetic energy at a radiofrequency of 27.12 MHz (K070541). The device is indicated for adjunctive use in the palliative treatment of postoperative pain and edema in superficial soft tissue. Palermo is a portable battery-operated device.

The Magnetofield (F& B International, Italy) and Elettronica Pagani (Energy Plus Roland Series, Italy) devices provide pulsed electromagnetic field therapy. They are currently marketed in Europe.

### IV. Rationale

Assessment of efficacy for therapeutic interventions involves a determination of whether the intervention improves health outcomes. The optimal study design for a therapeutic intervention is a randomized controlled trial (RCT) that includes clinically relevant measures of health outcomes. Nonrandomized comparative studies and uncontrolled studies can sometimes provide useful information on health outcomes but are prone to biases such as noncomparability of treatment groups, the placebo effect, and variable natural history of the condition. Evidence regarding treatments for arthritis can be confounded by many factors, including the natural variation of disease remission and progression in individual patients and subjective reporting. Therefore, evidence from large, rigorously designed RCTs, ideally observed over an extended period of time, is needed to adequately assess electrical stimulation outcomes.

Two recent systematic reviews reached somewhat different conclusions. A 2013 meta-analysis by Negm et al, including 7 small sham controlled RCTs with a total of 459 patients, examined pulsed electrical stimulation (PES) or pulsed electromagnetic field (PEMF) for the treatment of knee osteoarthritis (OA).\(^1\) The trials were published between 1994 and 2011, 5 were conducted outside of the United States, and only the trial by Fary et al\(^2\) (see next section) was considered to be at low risk of bias. There was no significant difference between the active and sham groups for the outcome of pain. Physical function was significantly higher with PES/PEMF, with a standardized mean difference of 0.22. The internal validity of the included studies is limited due to a number of factors. There is a high risk of bias and inconsistent results reported. The studies all have small sample sizes, leading to imprecise estimates of treatment effect (wide confidence intervals around outcomes).
A 2013 Cochrane review on PES and PEMF included 9 studies, with a total of 636 patients, that were published between 1993 and 2013.\(^3\) Meta-analysis found that participants who were randomized to PES or PEMF rated their pain relief as greater than sham-treated patients by 15.10 more on a scale of 0 to 100 but found no statistically significant effect on function or quality of life. There was a high risk of bias for incomplete outcome data in 3 studies. For all 9 studies, there were inadequacies in reporting of study design and conduct, making it unclear whether there was bias due to selective outcome reporting.

A number of the trials included in these meta-analyses are described next.\(^2,4-7\)

### Pulsed Electrical Stimulation (BioniCare)

**Randomized Controlled Trials**

In 2011, Fary et al reported results from a randomized double-blind sham-controlled trial of pulsed electrical stimulation in 70 patients with OA of the knee.\(^2\) The device used in this study was a commercially available transcutaneous electrical nerve stimulation (TENS) unit that was modified to provide pulsed electrical stimulation. Participants were instructed to apply the device for a minimum of 6 hours a day. In the placebo group, the device turned itself off after 3 minutes. After 26 weeks of treatment, 59% of patients using the active device and 36% of controls had achieved target usage based on patient-maintained logs. Intention-to-treat analysis showed a statistically significant within-group improvement in visual analog score (VAS) for pain over 26 weeks in both groups, but no difference between groups (VAS of 20 vs 19 for controls on a 100-mm scale). There was no significant difference between groups in the proportion of patients who achieved a clinically relevant 20-mm improvement in VAS pain score at 26 weeks (56% vs 44% of controls). There were no significant differences between groups for changes in Western Ontario and McMaster Universities Arthritis Index (WOMAC) Pain, Function, and Stiffness scores, Short-Form 36-Item Health Survey (SF-36) Physical and Mental Component Summary scores, patient’s global assessment of disease activity, or activity measures.

Zizic et al reported a 1995 multicenter, double-blind, randomized, placebo-controlled trial of pulsed electrical stimulation to assess pain relief and functional improvements in 78 patients with OA of the knee.\(^6\) Patients used the BioniCare or placebo device for 6 to 10 hours daily for 4 weeks and were allowed to continue nonsteroidal anti-inflammatory drug (NSAID) therapy. The placebo group used a dummy device that initially produced a sensation like the BioniCare device. Both patient groups were instructed to dial down the level to just below the sensation threshold. In the placebo group, the device would soon turn itself off. The primary outcomes assessed at baseline and after 4 weeks of treatment included patient assessment of pain and function and physician global evaluation of the patient’s condition. The authors reported that the BioniCare group had statistically significant improvement, defined as improvement of 50% or greater, in each of the primary outcomes assessed. The authors also assessed 6 secondary outcomes including duration of morning stiffness, range of motion, knee tenderness, joint swelling, joint circumference, and walking time. However, only a decrease in mean morning stiffness in the BioniCare group was statistically significant. While this study reports short-term

<table>
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<tr>
<th>POLICY TITLE</th>
<th>ELECTRICAL STIMULATION FOR THE TREATMENT OF ARTHRITIS AND MISCELLANEOUS CONDITIONS</th>
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<tr>
<td>POLICY NUMBER</td>
<td>MP-6.048</td>
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improvements with pulsed electrical stimulation using the BioniCare device, the authors note that long-term studies are warranted. In addition to longer term studies, larger studies would also be beneficial.

An industry-sponsored, randomized, double-blind, sham-controlled study of the BioniCare pulsed electrical stimulation device for 58 patients with OA of the knee was reported in 2007. Due to protocol violations from one of the centers (other new treatments were provided during the study) an additional 42 subjects were excluded from the analysis. Patients were instructed to wear the devices for 6 hours or more each day (typically at night), and compliance, which was monitored with a timer in the device, was found to be similar in the 2 groups (63% to 66% of patients, respectively). At the end of 3 months of use, the percentage of patients who improved 50% or more was greater with the active device group for patient global (39% vs 5%, respectively), patient pain (44% vs 16%, respectively), and WOMAC Pain (39% vs 11%, respectively) subscales. The percentage of patients who improved 50% or more on the WOMAC Stiffness (28% vs 5%, respectively) and WOMAC Function (23% vs 5%, respectively) subscales showed the same trend but did not reach statistical significance in this sample. As indicated, longer term larger controlled comparative studies are needed to evaluate this device.

Nonrandomized Controlled Trials
Reported in 2006 was a nonrandomized study of pulsed electrical stimulation in 157 patients (recruited from 23 centers) with moderate-to-severe knee OA who had received a recommendation for total knee arthroplasty (TKA). Patients were instructed to use the electrical stimulation device for 6 to 10 hours per day. The time to TKA was compared with a historical matched (age, sex, weight) control group of 101 knee OA patients treated at one of the centers. Analysis showed that 60% of patients in the electrical stimulation group had deferred TKA at 4 years, compared with 35% in the historical control group. Interpretation is limited due to the potential for higher motivation to avoid TKA in the subjects who agreed to participate in the study.

Uncontrolled Trials
In 2006, the BioniCare manufacturer published data on 288 patients with knee OA treated with the BioniCare device in an open-label prospective study. The study participants experienced improvements in patient assessment of pain and global evaluation of disease activity and physician global evaluation of the patients' condition. In addition, 45.4% reduced their use of NSAIDs by 50% or more. However, this study did not have a randomly assigned control group.

Pulsed Short-Wave Electromagnetic Field Stimulation
(Diatermed II, SofPulse™, and OrthoCor™ Active Knee System)

The literature on PEMF consists primarily of small RCTs with a variety of devices and ranges of treatment times (10 minutes to 12 hours). Some studies compared active PEMF to sham PEMF alone; others compared active PEMF plus physical therapy to sham PEMF plus physical therapy.
Most studies were conducted outside of the United States. Double-blind, sham-controlled trials assessing OA are described next.

**PEMF Versus Sham PEMF**

In 2011, Fukada et al reported a double-blind RCT from South America that included 121 women divided into 4 groups, low (19-minute treatment) or high-dose (38-minute treatment) short-wave electrical field stimulation with a Diatermed II (9 sessions over 3 weeks), placebo, or no-treatment control. Pain and function were measured with a numeric rating scale (NRS) and the Knee Osteoarthritis Outcome Score (KOOS) at baseline, immediately after treatment, and at 1-year follow-up. Except for the untreated controls, both patients and the physical therapist evaluator were blinded throughout the 1-year follow-up. When measured immediately after treatment, both the low- and high-dose groups showed significantly greater improvement than the control groups in the numeric rating scale and KOOS subscales. For example, the NRS decreased from 7.7 to 6.9 in the placebo group, from 7.1 to 3.8 in the low-dose group, and from 6.7 to 4.6 in the high-dose group. The percentage of patients who attained the minimal clinically important difference of 2 points on the NRS was 15% in the control group, 15% in the placebo group, 75% in the low-dose group, and 50% in the high-dose group. At the 1-year follow-up, in the low-dose group, but not the high-dose group, significant improvement remained on 3 of 5 KOOS subscales. Because there was a 36% dropout rate (from patients lost to follow-up, patients who received other therapies, and patients who had a total knee replacement), analyses were performed both per-protocol and by last observation carried forward; these analyses yielded similar results.

In 2016, Bagnato et al reported a double-blind, sham-controlled trial of 12 hours nightly treatment with a wearable ActiPatch. Sixty-six patients with OA were randomized and 60 completed the trial. After 1 month of treatment, there was a clinically significant decrease (25.5%) in VAS pain scores in the PEMF group compared with a 3.6% reduction in the sham group (effect size, -0.73; 95% CI, -1.24 to -0.19). WOMAC total score was reduced by 18.4% in the active treatment group compared to 2.3% for controls (effect size, -0.34; 95% CI, -0.85 to 0.17). SF-36 Physical Component Summary scores also improved significantly with nightly PEMF.

Wuschech et al evaluated 10-minute daily treatment with the Magcell Arthro (Physiomed Elektromedizin) in a sham-controlled, double-blind, semirandomized study with 57 patients with OA. Due to efficacy at the interim analysis, only the first 26 patients were randomized. The remainder was assigned to the active treatment group, although patients and assessors remained blinded to treatment condition. It is unclear whether this study was sufficiently powered, because power analysis indicated that 28 patients would be needed per group. Treatment was performed for 5 minutes, twice daily over 18 days. In the sham group, WOMAC total score was 56.9 at baseline and 56.2 at follow-up. In the active PEMF group, WOMAC total score decreased from 65.4 to 42.9. ITT analysis showed that the active PEMF group had a clinically and statistically significant reduction in pain (p<0.001) on the WOMAC compared to the sham group. Stiffness
(p=0.032) and disability in daily activities (p=0.005) on the WOMAC were also significantly reduced in the active PEMF group.

Nelson et al reported a randomized, double-blind, placebo-controlled pilot study with the Palermo device in 34 patients with OA. In addition to having knee pain with confirmed articular cartilage loss and an initial VAS score of 4 or more, only patients who had at least 2 hours of daily standing activity in a physical occupation were included in the study. Patients were instructed to use the electromagnetic device for 15 minutes twice daily. Patients were asked to self-report the maximum daily VAS pain score on a 10-cm line for weeks 1 and 2, and then for weeks 5 and 6. By the end of the study, 3 active and 7 sham patients had dropped out of the study (lack of perceived benefit). Using ITT analysis with last observation carried forward, the average decrease in VAS score was 2.7 in the active treatment group and 1.5 in the sham group. By 6 months, the maximum VAS score decreased by 39% in patients in the active treatment and by 15% in the sham group. The difference in VAS score between groups (4.19 for PEMF vs 6.11 for sham) was statistically and clinically significant. No additional studies with this device have been identified.

No RCTs with the OrthoCor Active Knee System were identified.

**PEMF Plus Physical Therapy Versus Sham PEMF Plus Physical Therapy**

A 2010, double-blind RCT from Turkey investigated the effect of PEMF plus physical therapy in 40 patients with knee OA. Patients with an average pain intensity of 40 or more on a 100-mm VAS were randomly assigned to PEMF or sham PEMF plus physical therapy for both groups. Sessions included 20-minute hot pack application, 5-minute ultrasound application, and 30 minutes of active or sham PEMF 5 times a week for 2 weeks, along with isometric knee exercises performed at home. After 2 weeks, both groups showed improvement in pain and functional scores on the WOMAC; there were no significant differences between the 2 groups. A 2016, double-blind, sham-controlled RCT of 40 patients with knee.

OA also found no benefit of 20 minutes of PEMF (PMT Quattro PRO; ASA) during physical therapy sessions as measured on either the VAS or the WOMAC pain scale.
Ongoing and Unpublished Clinical Trials

Some currently unpublished trials that might influence this review are listed in Table 1.

<table>
<thead>
<tr>
<th>NCT No.</th>
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<th>Completion Date</th>
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<td>NCT02436590a</td>
<td>A Prospective, Randomized, Double-Blind, Placebo Controlled Study to Evaluate Efficacy and Safety of an Active Pulsed Electromagnetic Field for the Treatment of Osteoarthritis of the Knee</td>
<td>150</td>
<td>Jul 2017</td>
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NCT: national clinical trial.
* Denotes industry-sponsored or cosponsored trial.

Summary of Evidence

For individuals who have arthritis who receive electrical stimulation, the evidence includes a number of small randomized controlled trials (RCTs). Relevant outcomes are symptoms, functional outcomes, health status measures, and treatment-related morbidity. A review of the literature did not find adequate evidence that use of pulsed electrical or electromagnetic stimulation for the treatment of arthritis will improve health outcomes. A 2013 meta-analysis identified 9 randomized sham-controlled trials on treatment of osteoarthritis (OA) of the knee. There was some evidence of improved function but no evidence of reduced pain. These conclusions are limited by methodologic shortcomings and inconsistency of trial results. More recent RCTs have also had variable results, which may be related to the different devices used and different durations of treatment. Additional studies with larger numbers of subjects are needed. The evidence is insufficient to determine the effects of the technology on health outcomes.

Practice Guidelines and Position Statements

The American Academy of Orthopaedic Surgeons published guidelines on the treatment of osteoarthritis of the knee in 2013.\(^{14}\) Due to the overall inconsistent finding for electrotherapeutic modalities, they were unable to make a recommendation for or against their use in patients with symptomatic osteoarthritis of the knee. The strength of the recommendation was inconclusive.

U.S. Preventive Services Task Force Recommendations

Not applicable.

V. DEFINITIONS

510 (K) is a premarketing submission made to FDA to demonstrate that the device to be marketed is as safe and effective, that is, substantially equivalent (SE), to a legally marketed device that is not subject to premarket approval (PMA). Applicants must compare their 510(k) device to one or more similar devices currently on the U.S. market and make and support their substantial equivalency claims.
OSTEOARTHRITIS is a type of arthritis marked by progressive cartilage deterioration in the synovial joints and vertebrae.

RHEUMATOID ARTHRITIS is a chronic, inflammatory, destructive, and sometimes deforming collagen disease that has an autoimmune component. It is characterized by symmetric inflammation of synovial membranes and increased synovial exudate, leading to thickening of the membranes and swelling of the joints.

VI. BENEFIT VARIATIONS

The existence of this medical policy does not mean that this service is a covered benefit under the member's contract. Benefit determinations should be based in all cases on the applicable contract language. Medical policies do not constitute a description of benefits. A member’s individual or group customer benefits govern which services are covered, which are excluded, and which are subject to benefit limits and which require preauthorization. Members and providers should consult the member’s benefit information or contact Capital for benefit information.

VII. DISCLAIMER

Capital’s medical policies are developed to assist in administering a member’s benefits, do not constitute medical advice and are subject to change. Treating providers are solely responsible for medical advice and treatment of members. Members should discuss any medical policy related to their coverage or condition with their provider and consult their benefit information to determine if the service is covered. If there is a discrepancy between this medical policy and a member’s benefit information, the benefit information will govern. Capital considers the information contained in this medical policy to be proprietary and it may only be disseminated as permitted by law.

VIII. CODING INFORMATION

Note: This list of codes may not be all-inclusive, and codes are subject to change at any time. The identification of a code in this section does not denote coverage as coverage is determined by the terms of member benefit information. In addition, not all covered services are eligible for separate reimbursement.

Investigational; therefore not covered:

<table>
<thead>
<tr>
<th>HCPCS Code</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>E0762</td>
<td>Transcutaneous electrical joint stimulation device system, includes all accessories</td>
</tr>
</tbody>
</table>
IX. REFERENCES


Other Sources:

X. POLICY HISTORY

| MP 6.048 | CAC 10/25/2011 Adopted BCBSA. New Policy, information regarding BioniCare, BIO-1000 removed from MP- 6.020 Electrical Stimulation Modalities, and created in this separate policy. No change to policy statement, remains investigational |
| CAC 10/30/12 Consensus review. References updated; no changes to policy statement. Codes reviewed 10/26/120 |
| CAC 11/26/13 Consensus. No change to policy statements. References updated. Rationale section added. Changed FEP variation to reference the policy manual. |
| CAC 11/25/14 Consensus review. No changes to the policy statements References and rationale updated. Background updated with new devices. Codes reviewed, no changes. |
| 07/15/16 Administrative posting. LCD revised to reflect Noridian LCD 34821 |
| CAC 11/29/16 Consensus Review. No changes to the policy statements References and rationale updated. Coding reviewed. Variation reformatting. |

Top