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Electrical Stimulation of Bone Healing

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Bone is one of the tissues in the human body with the ability to mend itself when injured in much the same way as skin and other tissues can. Once a break in the bone occurs, bone repair usually assures a solid union within a few months. There are circumstances which may interfere with that process.

Occasionally, the formation of new bone is slow and the break fails to heal properly, usually because scar tissue has filled the gap where new bone was expected to occur or circulation to the broken area is decreased.

Frequently, when a bone does not heal, a medically prescribed bone healing system can be used to promote healthy bone growth and repair when normal bone healing has not appeared to be satisfactory. EBI provides three different bone growth technologies and was FDA approved for human use in 1978. (EBI Electrobiology, Inc.) The EBI Bone Healing System is a proven safe and effective method for promoting the healing of fractures that have not mended spontaneously and there are no side effects associated with this treatment. In fact, the EBI treatment does not produce any sensation felt by the patient.

Pulsed Electromagnetic Field (PEMF)

One type of unit uses PEMF (pulsed electromagnetic field) technology. The system consists of a treatment coil that is incorporated into the cast or placed directly on the skin over the fracture site. A treatment unit is programmed to the patient's specific fracture needs.

The treatment unit produces a small electrical current which travels to the treatment coil producing a pulsating electromagnetic field around the fracture.

This electromagnetic field produces a small electrical current similar to what the body does naturally to signal the bone to begin healing in the first few weeks after the initial fracture. Just as the patient is unaware of the electrical current produced by their own body, they are not aware of the electrical current produced by the bone healing system. This technology is supported by a scientific law known as Wolff's Law.

The system is very safe and has been widely adopted because of its proven success in the absence of any known risks. It does not require surgery and has no side effects. All areas of the body and all fracture types can be accommodated by the bone healing system. The usual healing time is similar to that expected following surgery for an un-united fracture. Two to four months would be an average time for healing of a fracture. Ten hours is the recommended treatment time so many people find it convenient to use the bone healing system while they are sleeping.

Capacitive Coupling (CC)

Another type of unit uses capacitive coupling technology. Capacitive coupling electrical stimulation is indicated for appendicular nonunions and spinal fusions. This type of unit consists of a small stimulator unit with two light-weight, low profile electrodes protruding. The unique

capacitive coupling signal treats all fracture sites within the area of electrodes which are applied externally directly over the fracture or fusion site.

The Orthopak is the capacitive coupling unit indicated for long bone nonunions acquired secondary to trauma. The Spinalpak is used as an adjunct to primary lumbar fusion surgery for one or two levels.

This type of unit offers 24 hour treatment with daily changing of the battery. One sized unit treats all areas at the fracture site.

The mechanism of action with capacitive coupling is that the low voltage alternating current applied to the site increases the flow of calcium ions into osteoblasts (cells which deposit new bone). Growth factors are unregulated which also enhances osteoblastic activity.

Direct Current (DC)

The third type of technology is direct current. This type of bone growth stimulator is implanted at the time of surgery. It consists of a small generator connected to one or two lead wires also known as the cathodes. The cathode or cathodes are placed in the area needing bone stimulation.

There are two direct current options. The Osteogen is an implantable bone growth stimulator used for long bone nonunions. The SpF is implanted during spinal fusions as an adjunct to the surgery.

Since this type of technology is totally implanted, therapeutic treatment at the nonunion site is constant. When necessary, after healing has occurred, the generator can be removed as an outpatient procedure using local anesthetic.

Electrical stimulation of the bone healing is a very old technique and has been studied for at least 25 years. It has only been in recent years, however, that the technology has been available to effectively treat fractures with the same level of success as surgery. We have used this technology with the EBI coils in a large number of patients with very good success.

Only EBI is the leader and innovator of bone growth technologies since 1980 with more than 500,000 patients treated and over 300 published studies.

Additional Information

This is very "heavy", so read at your own risk!

The mechanism of action behind the PEF technology involves the up regulation of factors that modulate normal bone healing. PEF increases a number of factors such as tissue growth factor beta, bone morphogenic protein 2 and bone morphogenic protein 4 which are normal physiological regulators of the various stages of bone healing, including angiogenesis, chondrogenesis and osteogenesis.

The mechanism of action behind the EBI direct current stimulation technology involves the up regulation of a number of osteoinductive growth factors including bone morphogenic protein 2, 6, 7 and bone morphogenic protein 2 receptor ALK 2 which are normal physiological regulators of various stages of bone healing including chondrogenesis and osteogenesis.

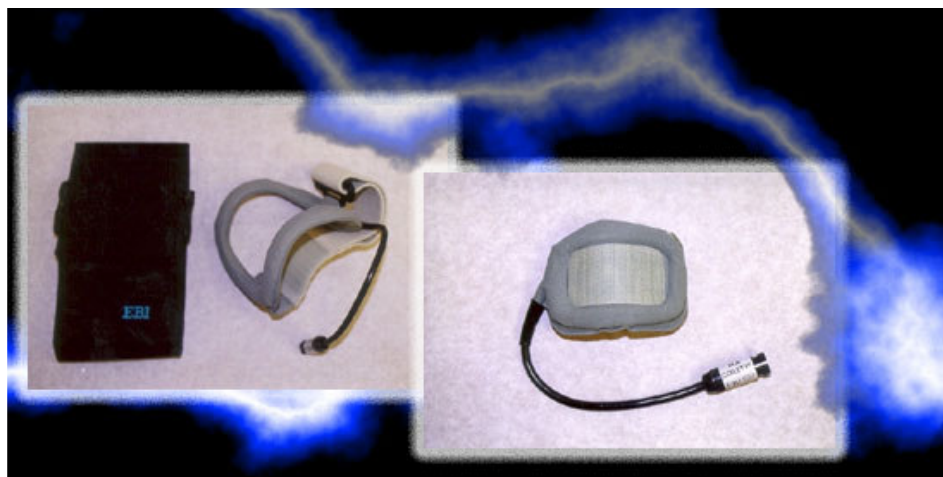
In addition, an electro-chemical reaction at the cathode lowers oxygen concentration and increases pH. These reactions result in enhanced osteoblastic activity and decreased osteoclastic activity.

The mechanism of action behind the EBI capacitive coupling stimulation technology involves the up regulation of factors that modulate normal bone healing such as tissue growth factor beta and PGE which results from transmembrane calcium translocation via voltage-gated calcium channels and subsequent activation of calmodulin.

Only EBI has demonstrated that their bone growth technologies stimulate a cascade of bone morphogenic protein and other osteopromotive growth factors. Also, EBI is the only company that provides data for proven bone morphogenic protein (BMP) up regulation.

I warned you that the information was going to be very heavy and difficult to understand. However, it does happen to be true and is the basis of why the electrical-stimulation of bone healing is so effective.

We are using it on a daily basis in our practice.



Thank you for using the Online Orthopaedics Library.

We hope it was useful to you. Please check back frequently because new topics and information are being added continuously by Dr. Haverbush.

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Date Created: 03/12/05
Last Reviewed: 03/12/05
Last Updated: 03/12/05

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