PEMF device therapy in children: safety and usefulness

I have long been interested in the use of pulsed electro magnetic fields (PEMFs) in children. PEMFs are generally significantly underutilized in children. This is primarily due to the fact that most professionals who use PEMFs have tended to be limited in their use in adults and the lack of education of people who work with children and parents in the value of PEMF therapy.

Evidence from my first book

My first book, "**Magnetic therapy in Eastern Europe: a review of 30 years of research**," had a chapter on studies reported for the use of magnetic field therapies in children. These included benefits found for sinusitis, heart arrhythmias, Legg-Perthe's disease, enuresis and other orthopedic conditions. For sinusitis, PEMF therapy was found to be significantly effective for mild to moderate sinusitis. Children requiring antibiotics often only required one antibiotic, versus multiple antibiotics in more complex and refractive infections. None of the children with magnetic field therapy needed to have sinus procedures. Because of the concern for the risk of brain changes near the brain with magnetic field exposure, a number of children were tested for EEG changes and none were found.

For **cardiac arrhythmias**, PEMF therapy to the upper back, using magnetic fields ranging in intensity from 90 to 190 Gauss, children had significant benefit, especially those who work quite weak. Another group of children were studied and compared to treatment with medications and sham treatment. Again, the neck and upper back area were treated with 68% of the children treated with magnetic therapy and medication having improvement compared to only 15% of those with sham magnetic therapy plus medication. Heart racing [tachycardia] episodes were less frequent and shorter in duration. The best results were seen in those children with excessive vagal stimulation without heart defects.

Legg-Perthe's disease (also called Legg-Calvé-Perthes disease) (LCPD) involves damage to the hip from the lack of blood supply - avascular necrosis (AVN). LCPD usually occurs in children aged 4-10 years. The disease has a gradual onset and may occur after an injury to the hip. It often requires significant surgery and can result in major disability. Children treated with PEMFs had an improvement in hip motion of 82% and 79% had objective improvement of the condition on x-ray. Improvements can last a long time even after one's short course of PEMF therapy. However, long-term PEMF therapy is recommended until the condition is resolved or become stable.

Enuresis, already dealt with in a previous blog https://www.drpawluk.com/blog/nocturnal-enuresis-bedwetting/, was also evaluated. Enuresis, which can be nighttime or daytime bladder leakage, can happen in children and can continue into adulthood. It is estimated to occur in about 20% of 5-year-olds and about 10% of 10 year-olds. In children older than age 10, episodes of leakage resolve spontaneously at about 15% per year. Treatment with PEMFs was dramatically more effective than sham treatment, for both subjective and objective bladder function measures.

Results for **miscellaneous orthopedic conditions** were also reported including Keller disease, Koenig's disease, Osgood Schlatter disease and postoperative femoral head damage. 80% of children had at least some benefit. 50% of the magnetic therapy group had excellent results with improvements in pain, edema, range of motion and x-rays. Only 12 patients out of 91 had no benefit. None had to have surgery.

Chronic bronchitis was also studied in children with benefit. There is also a section in the book about lung diseases showing significant benefits for asthma, chronic lung inflammation, and tuberculosis. All of these happen in children and similar or better results would clearly be seen in children.

Whatever PEMFs do in adults is likely to work even better in children

The general expectation is that whatever works in adults is likely to work even better in children. because of the fact that children heal faster and regenerate tissues better. This example was brought home to me stunningly when I treated a 3-year-old child whose thumb was cut off in a doorjamb just behind the nail bed. The detached part of the thumb was replaced and PEMF coils, about 200 Gauss at 10 Hz/100 Hz, were applied for 1 ½-3 hours per day. After 12 weeks the thumb had completely regenerated including the growth of a new fingernail. A picture and description of this are in the book "**Power Tools for Health: how magnetic fields [PEMFs] help you.**"

As an example, research shows that children with fractures heal better at younger ages than older ages. (*Hufnagel*) For example, complete healing of fractures of the long bones occurs on average about 62 days faster in children under 19 years of age compared to those over 19 years of age. So, what happens faster in younger children naturally will happen even faster with PEMF stimulation. Because healing happens faster with PEMF stimulation, in general, whether it's due to injury, congenitally, following surgery or otherwise, this is even more likely to occur in children. The result is faster healing and reduced risk of breakdown, complications and side effects of treatments.

Another aspect of more rapid healing in children is related to the metabolic rate. Children have very rapid metabolic rates, about 2 ½ times higher than adults. The highest are in the first 5 years of life, leveling off into the teen years and beyond. (*Son'kin*) More rapid metabolic rates equate to rapid healing and recovery.

There are huge anatomic, physiologic and metabolic differences between infants, children, adolescents and adults, although adolescents are much more like adults. The bodies of infants and children are much more dynamically reactive physiologically and, of course, their bodies and organs are smaller. Because of these differences PEMF therapy should likely be applied differently. This is especially true for the length of treatment time, the intensity of the magnetic field and the need to go "low and slow" to observe for response and adjust treatment parameters accordingly. This approach is even more important in children who are vulnerable with significant health issues and handicaps and in situations of acute and more severe problems or disturbances.

Acute infectious diseases

The most common childhood illnesses are acute infectious diseases, particularly in the respiratory and gastrointestinal tracts. Most of the time PEMFs are not needed to help with recovery, since children generally recover quickly on their own, even if they need antibiotics. Other words it may not be necessary to purchase a PEMF system just to deal with an acute infectious process. However, if a family already owns a PEMF system, PEMFs can be applied early on in the infectious process to speed healing and recovery. This can be especially important in dealing with ear infections [including mastoiditis], sinus infections and upper respiratory infections with significant gland enlargement, such as infectious mononucleosis [mono]. Since mono can be fairly severe, resulting in significant loss of school time, PEMFs should be able to help accelerate healing and recovery. This may be especially true when the

infection causes the complication of hepatitis. Dental infections are also fairly common and PEMFs work well in this situation.

How do PEMFs help infectious conditions? Much of this is covered in the **"Power Tools for Health book**." To summarize, PEMFs have some degree of killing action on bacteria, but have a bigger impact on decreasing the growth of organisms and therefore limiting the infection. Like the antibiotics, that don't kill bacteria, versus antibiotics that do, PEMFs are more likely to limit growth than kill existing organisms. To do this magnetic fields need to be used for longer periods of time and need to be the stronger magnetic fields. PEMFs probably have the most benefit with infectious conditions by improving the function of immune cells cells that kill bacteria [phagocytes]. These immune cells become better bacterial hunters, are better at trapping bacteria and have increased size. The combination of PEMFs and antibiotics can reduce the treatment time, compared to using antibiotics alone. Bacterial breakdown products can persist long after an acute infection, causing long-term inflammation. PEMFs significantly reduce the inflammation caused by these breakdown products.

PEMFs also help with viral infections by causing developing viruses to have defective particles, rendering the viruses less active and secondarily helping the cells to be healthier and recover faster from the infection. Very low intensity PEMFs, available with whole body PEMF systems, and with frequencies between 50 – 1000 Hz, have numerous actions on the viruses and viral infected cells, to limit or decrease the degree of infection. In this sense, these lower intensity/higher frequency PEMFs could be used for prevention as well as treatment of viral infections. A general action of PEMFs, that helps infections with almost any type of virus, is the induction of general virus suppressor substances in virally infected tissues that regulate and suppress viral growth. So, these viral suppressor substances do not prevent infections in the first place but will reduce and limit replication, growth and spread of the infection.

A very important aspect of the benefit of PEMFs for infections is the risk that bacteria may become resistant to antibiotics or to mutate. Antibiotics, insecticides or pesticides can cause bacteria to mutate and become treatment resistant, even during a single course of infection, causing these infections to become chronic and challenging to treat. PEMFs inhibit mutagenic transformation will. This means that the use of PEMFs during an acute bacterial infection will not only accelerate the healing of the tissues but reduce the risk of the infection becoming resistance to conventional treatments.

Even with fungal infections, PEMFs, combined with antifungal agents, kill almost 90% of fungi rapidly versus only 43% effectiveness with medication alone. Since some antifungal therapies can be toxic, PEMFs combined with them would allow for much lower dosing, for shorter periods of time, to produce better results, faster and more safely.

Acute infections place a huge demand on the production of ATP, the primary energy source of cells, to help to fight the infection. PEMFs can increase the production of ATP between 100 to 600%, helping the tissues to be able to better and faster combat the ravages of the infection in the cells.

Because of the many actions of PEMFs, including reducing chronic inflammation, edema, improving circulation and accelerating tissue repair, PEMFs applied early and throughout the infectious process, can help with limiting infections and speeding healing and recovery.

In summary, PEMFs can have an important role in helping children dealing with infections. Most of the most commonly used PEMFs will not like the directly kill bacteria or viruses. They will facilitate the body's ability to defend itself better and faster and accelerate healing and recovery. Because infectious processes can be unpredictable, depending on many factors, both internal and external, is generally recommended that PEMFs be combined with antibiotics, antivirals and antifungals to produce the best and most predictable results. The combination appears to be much more effective and reliable than either one alone.

Children with Chronic Conditions

What is a chronic condition?
All children will likely have many different health problems during infancy and childhood, but for most children these problems are mild, come and go, and do not interfere significantly with daily life and development. For some children, however, chronic health conditions can be more severe and limiting, affecting everyday life throughout childhood.

We'll define a chronic health condition as a health problem that lasts over three months, affects your child's normal activities, and may require hospitalizations and/or home health care and/or extensive medical care.

A chronic condition is an "umbrella" term. Children with chronic illnesses may be ill or well at any given time, but they are always living with their condition.

Some examples of chronic conditions include (but are not limited to):

- Abdominal pain
- ADD/ADHD
- Asthma (the most common)
- Autism
- Bone growth issues
- Cerebral palsy
- Chronic ear problems
- Chronic infections
- Colic
- Complex regional pain syndrome (CRPS)
- Congenital heart problems
- Cystic fibrosis
- Developmental disorders
- Diabetes
- Ehlers Danlos Syndrome
- Enuresis
- Epilepsy
- Headaches
- Immunodeficiency
- Learning disorders
- Orthopedic issues
- Pain syndromes
- Reduced healing rates
- Seizure disorders
- Sickle cell anemia
- Sleep issues in children
- Spina bifida

Below is a discussion about how PEMFs may be able to help these various chronic conditions. It is rare that PEMFs can or should be used alone. Generally multiple strategies may be needed to most effectively deal with these conditions. Sometimes, however, PEMFs can be used as the sole source of benefit.

- **Abdominal pain** - experience shows that abdominal pain is helped very well and quickly. It may be best to use PEMFs primarily for chronic abdominal pain problems with well-established diagnoses and limited risks. Examples would be centrally mediated abdominal pain syndrome, pulled muscle, postoperative pain, PMS pain, or Crohn's disease **PLEASE NOTE: PEMFs can work so well for abdominal pain that they may mask a potentially severe evolving acute process. A diagnosis is always important before treating abdominal pain to be sure a problem is not masked. An example is an appendix that's about to rupture. PEMFs may stop the pain, postponing or stopping further treatment, such as the possible need for appendectomy, thus, allowing the appendix to rupture if no appropriate and definitive action is taken.**
- **ADD/ADHD** - can be helped with PEMFs that allow selection of frequencies that can entrain the brain to the desired brain frequency patterns, most typically by slowing down parts of the brain; occasionally speeding up some parts of the brain. A typical frequency would, commonly, be in the alpha EEG range, 8-13 Hz, 10 Hz being the most common.
- **Anxiety, panic and phobias** - can be helped with PEMFs that allow selection of frequencies that can entrain the brain to the desired brain frequency patterns, most typically by slowing down parts of the brain; occasionally speeding up some parts of the brain. A typical frequency would, commonly, be in the alpha or theta EEG range, 8-13 Hz and 5-8 Hz, 10 Hz being the most common. See also http://www.heraldopenaccess.us/fulltext/Alternative-Complementary-&-Integrative-Medicine/Pulsed-Magnetic-Field-Treatment-of-Anxiety-Panic-and-Post-Traumatic-Stress-Disorders.php
- **Asthma** - asthma is mostly a chronic condition with flareups. Eastern European research has found that stimulating over the upper back [thoracic area] can help significantly in reducing bronchial spasticity. Additionally, the same PEMFs applied over the front of the chest can help to reduce inflammation in the bronchial passages, reducing the frequency of flareups and the need for rescue medication.
- **Autism** - if a child can tolerate the application of PEMFs to the head, PEMFs can be stress/anxiety reducing to the child. Children who are very low energy may be able to be stimulated to be more alert. A typical frequency would, commonly, be in the alpha EEG range, 8-13 Hz, 10 Hz being the most common.
- **Bone growth issues** - PEMFs may be applied to the epiphyses to enhance bone growth, possibly avoiding bone lengthening procedures.
- **Cerebral palsy (CP)** - children with CP often have significant spasticity in their extremities. PEMFs applied to the neck and/or brain have been found to reduce spasticity.
- **Chronic ear problems** - PEMFs applied to the ears may help to reduce the degree of inflammation and fluid production in the inner ear and reduce recurrent ear infections.
- **Chronic infections** - see the discussion above about infections.
- **Colic** - this may be caused by temperature adjustments, inability to self soothe, gas, or dairy allergy. PEMFs can be dramatically beneficial in reducing colic attacks. They may safely be used over the belly all night long.
- **Complex regional pain syndrome (CRPS)** - see the section below on chronic pain.
- **Congenital heart problems (CHD)** - PEMFs are not expected to reverse congenital heart problems. They may help the heart to beat or function better because of the increased workload the heart has when there is a CHD. Many children have to wait, often years, before corrective surgery is possible. PEMFs can be used during this time to improve function. They may also be able to be used during the recovery following surgery to speed chest and heart tissue healing.

- **Cystic fibrosis [CF]** - PEMFs do not reverse cystic fibrosis. The primary expected benefit with CF is to reduce inflammation in the lungs, make the tissues healthier to be able to resist the development of infections and may help clear lung secretions better by making them less thick.
- **Depression -** as with anxiety, depression in children and adolescents may be helped by treating the brain, using entrainment principles. Depression related to hormonal changes may be helped but may be less likely to be improved as much. High intensity PEMFs in adults have been very useful in the treatment of depression and would be potentially safer to use than medication. Working closely with a mental health professional is very important if PEMFs are going to be attempted in lieu of counseling and/or medication.
- **Developmental disorders** - PEMFs are not likely to reverse developmental disorders but may help with many of the emotional aspects associated with them. can be helped with PEMFs that allow selection of frequencies that can entrain the brain to the desired brain frequency patterns, most typically by slowing down parts of the brain; occasionally speeding up some parts of the brain. A typical frequency would, commonly, be in the alpha EEG range, 8-13 Hz, 10 Hz being the most common.
- **Diabetes** - most diabetes in children is type I. Is unknown whether PEMFs may help to reduce the severity and progression of this form of diabetes. If this is to happen it would need to be applied to the pancreas very early in the development of the diabetic process. In addition, PEMFs may be very helpful in reducing the development and recovery from infections and wounds.
- **Ehlers Danlos Syndrome** - see the section below on chronic pain.
- **Enuresis** – see https://www.drpawluk.com/blog/nocturnal-enuresis-bedwetting/
- **Epilepsy and seizure disorders** – see https://www.drpawluk.com/blog/pemfs-seizures-epilepsy/ PEMFs may be very useful in reducing the incidence and severity of seizures, whatever the cause. They can do this by reducing the excitability of the brain tissues leading to seizures and decreasing any inflammation present. It is not known for any given child whether medication may be able to be reduced or stopped. If use of PEMFs appears to be effective, it is recommended to work with the pediatric physician to attempt dosing reduction attempts.
- **Headaches** - see the section below on chronic pain
- **Immune disorders** - every immune disorder is unique. PEMFs can be used with many of them, not so much to reverse the immune disorder, than to deal with pain, inflammation, tissue damage and improve the value and reduce the side effects of medications.
- **Immunodeficiency** - PEMFs are unlikely to affect the underlying immunodeficiency disorder. The main value of PEMFs is likely to revolve around helping the body to be less severely affected by infections and recover faster as well as helping with wound healing. PEMFs would help with any associated pain issues as well.
- **Learning disorders** - can be helped with PEMFs that allow selection of frequencies that can entrain the brain to the desired brain frequency patterns, most typically by slowing down parts of the brain; occasionally speeding up some parts of the brain. A typical frequency would, commonly, be in the alpha EEG range, 8-13 Hz, 10 Hz being the most common. These children often have significant anxiety. See the discussion on anxiety above.
- **Obesity** – weight issues in children and adolescents can often be related to stress and anxiety. See the anxiety discussion above. Also, see https://www.drpawluk.com/blog/overweight-obesity-and-pemfs/

- **Orthopedic issues** - see the section below on chronic pain. Also, PEMFs can be very important in helping to heal osteomyelitis, even when combined with antibiotics and surgery. In some cases surgery may be able to be avoided when PEMFs are used.
- **Pain syndromes** - see the section below on chronic pain
- **Reduced skin or wound healing rates** - reduced healing can be a consequence of many issues, infectious, metabolic, immune, toxicities etc. In general, PEMFs help and speed healing from almost any kind of problem.
- **Sickle cell disease** - PEMFs are unlikely to significantly impact this genetic condition directly. Regular use of PEMFs is expected to improve circulation in the tissues and prevent or reduce crises. Whole body PEMF treatment is necessary every day. During crises higher intensity PEMFs may be needed in the area of the body experiencing the crisis. PEMFs may be able to help reduce dependency on pain medications.
- **Sleep issues** - this is an extremely common problem in children. Up to 50% of children will experience a sleep problem. Because children's brains are very sensitive to PEMFs, Delta or Theta range frequency PEMFs applied under the pillow or over the abdomen throughout the night can be extremely helpful. They are safe and non-toxic. Lower intensity whole body PEMFs through the night may be tried if local treatment under the pillow is not effective.
- **Spina bifida** - there are many aspects to spina bifida, depending on the severity. PEMFs may be able to help with bowel and bladder function and reduce spasticity. Infections in the area of the spina bifida may also be helped significantly with PEMFs.

The above is of necessity a relatively short list of all the possible chronic problems children may have. Once the basic mechanisms of the effects of PEMFs are understood, most chronic conditions may be benefited to varying degrees by the use of PEMFs alone or in combination with standard therapies. Most of the basic mechanisms of actions of PEMFs are covered in the book, "**Power Tools for Health**."

Even though the above conditions are very different illnesses, kids and families dealing with any chronic condition have a lot in common. Learning to live with a chronic condition can be very challenging for a child, for parents, siblings, friends and family members. PEMFs may be very helpful for these children with chronic conditions, reducing symptoms, ability to function and improving healing and recovery.

Chronic pain in children

One of the most common uses of PEMFs in general is for the management of pain. Since PEMFs are very safe, they should undoubtedly be considered for helping children in chronic pain.

How common are chronic pain conditions in children?
Pediatric chronic pain is a significant problem. About 20-35% of children and adolescents are affected by it worldwide. (*Friedrichsdorf*) More than 10% of children hospitalized for any cause have chronic pain. Untreated chronic pain in children has a high risk for development of pain and psychological disorders later in life. Seventeen percent of adult chronic pain patients report a history of chronic pain in childhood or adolescence, with about 80% saying that the pain in childhood continued and persisted until adulthood. One study of 1336 children and teens in pain, ages 11–14 years, found 44% had

increased risk of pain disorders and conditions, primarily headaches, back pain, abdominal pain and facial pain, and 12% had persistent pain.

About 15% to 18% of children in the United States live with chronic pain. In one hospital study, the types of pain (many overalpping with more than one type) included:

- 74% had chronic or recurrent musculoskeletal pain
- 61% had primary headaches (tension-type/migraines)
- 38% had CAPS "centrally mediated abdominal pain syndrome"
- 11% had CRPS type I
- 26% had additional or accompanying underlying conditions, including
    - Avascular necrosis
    - Caffey's disease
    - Cerebral palsy/spasticity
    - Chiari-I-malformation with ventricular-peritoneal (VP) shunt
    - Chronic postsurgical pain
    - CRPS type 2
    - Erythromelalgia
    - Inflammatory bowel disease (Crohn's disease, ulcerative colitis)
    - Irritable bowel syndrome
    - Juvenile rheumatoid/idiopathic arthritis (JRA/JIA)
    - Malignancy
    - Muscular dystrophy
    - Progressive neurodegenerative/metabolic conditions incl. mitochondriopathies
    - Sickle cell disease

Each of these conditions would have to take into account both the child and the type of physical aspect of the pain condition when considering the use of PEMFs. One size does not fit all! Every individual circumstance would have to be taken into account when considering the type of PEMF system to use and how it should be used. Professional input from somebody expert at PEMFs is recommended, who would have a broad knowledge about available PEMFs and an understanding about the physical changes involved with each condition and the likely impact of PEMFs. PEMFs are unlikely to completely reverse these conditions. It's necessary to set specific objectives and expectations for what PEMFs can help for any of these conditions. In most cases PEMFs can help significantly with symptoms and function.

How do PEMFs help with pain?

Static EMFs have been used for centuries to control pain and other biologic problems. This review explores the value of magnetic therapy in managing pain, presenting the scientific basis supporting these modalities. PEMFs of various strengths, waveforms, and frequencies have been evaluated, depending on the clinical conditions or aspects selected for the study. There is as yet no *gold standard* PEMF. And, it is doubtful that there ever will be because of the very nature of the complexities involved. After thousands of patient-years of use globally, very little risk has been found with MF therapies (Markov, 2004). There are precautions or contraindications for implanted electrical devices, pregnancy

(because of lack of data), and rarely for seizures with certain kinds of frequency patterns in seizure-prone individuals.

PEMFs affect pain perception in many different ways. These actions are both direct and indirect. Direct effects of PEMFs are on nerve firing, calcium ion movement, improved membrane charges, increased endorphin, nitric oxide, and dopamine levels, acupuncture actions, and accelerated nerve regeneration. Indirect benefits of PEMFs are seen because of physiologic function enhancement on circulation, muscle, edema, tissue oxygen, inflammation, healing, prostaglandins, cellular metabolism, and cell energy levels (Jerabek and Pawluk, 1996).

Pain relief often happens in three stages: rapid, intermediate and long-term. Rapid pain relief most often happens as a result of a direct action in reducing pain, called anti-nociception. In this case pain relief happens by action on pain receptors in the tissues, called mu opioid receptors. In many cases this can be similar in the amount of pain relief to taking morphine. Intermediate pain relief happens due to functional physiologic changes in the tissues such as reduction of muscle spasm, edema and inflammatory prostaglandins and improvement of circulation, tissue oxygenation, cellular metabolism and cellular energy levels. These changes can improve tissue function, health and healing regeneration over longer periods of time. These changes that take longer to happen are more likely to help to reverse the underlying causes of the pain, thus producing a more permanent benefit.

Pain relief mechanisms vary by the type of stimulus used (Takeshige and Sato, 1996). For example, needling to the pain-producing muscle, application of a static MF or external qigong, or needling to an acupuncture point all reduce pain by different mechanisms. In guinea pigs, pain could be induced by reduction of circulation in muscle (ischemia), such as can happen with significant edema and muscle spasms, and can be reduced or reversed by recovery of circulation.

Specific chronic pain conditions

- **Chronic or recurrent musculoskeletal pain** - the use of PEMFs can be dramatic in reducing these types of pains. Longer-term use may be needed. When the problem is local, portable, battery-operated devices baby helpful. When pain is over larger areas or in multiple areas of the same time, whole body PEMF systems baby needed.
- **Ehlers Danlos Syndrome (EDS) -** the most common aspect of EDS is excessive ligamentous laxity. These children are often double-jointed leading to excessive motion of joints under load. The result is chronic mild or moderate ligamentous or joint strains and joint damage. While PEMFs have been shown to increase the production of collagen and may therefore strengthen tissues, their major role in EDS is likely to be the reduction of inflammation, more rapid repair and regeneration of tissue strains, the reduction of pain and delayed progression of development of arthritic change. Because this is a condition involving all the ligaments in the body, whole body PEMF treatment is recommended using higher intensity PEMFs. The earlier in the process PEMFs a started the better the preservation will be of the tissues and joints.
- **Primary headaches (tension-type/migraines)** - tension headaches are more like musculoskeletal pain, and applied to the back of the head. Migraines have vascular, hormonal and inflammation components. In this case, PEMFs are applied locally to the base of the head or over the head

directly with either portable or higher intensity PEMF systems. In chronic or recurrent migraines, PEMF therapy may be needed regularly for prevention purposes as well as for treatment.

- **CAPS "centrally mediated abdominal pain syndrome" -** Repeated injury in the abdomen can cause nerve receptors to become overly sensitive. For instance, if someone has had multiple abdominal surgeries or an infection, a later painful occurrence may be experienced as more painful than previously. Even normal abdominal activity may be experienced as being painful. It is as if the volume has been turned up on a stereo receiver. This condition is called visceral hypersensitivity (increased sensitivity of the intestines). Even small amounts of intestinal disturbance can be exaggerated to produce severe pain (central hypersensitivity). When someone is feeling anxious or depressed, or focuses attention on the pain, it is experienced as more severe. PEMFs can be used over the abdomen and over the brain to to reduce both the local nerve sensitivity and also the brains hyperreactivity. Either small portable PEMFs can work for this or a larger PEMF pad.
- **CRPS (complex regional pain syndrome)** - a chronic (more than six months) pain condition that most often affects one limb (arm, leg, hand, or foot) usually after an injury. CRPS is likely caused by damage to, or malfunction of, the peripheral and central nervous systems. CRPS shows prolonged or excessive pain and changes in skin color, temperature, and/or swelling in the affected area. There are two types: CRPS-I and CRPS-II. CRPS-I (previously known as reflex sympathetic dystrophy syndrome) are less likely to have a confirmed nerve injury. CRPS-II (previously known as causalgia) is when there is an associated, confirmed nerve injury. But, there can be overlap between these 2 types. Severity of the problem can vary tremendously. Whether there is a known nerve injury or not, treatment can be applied both locally, anywhere along the spinal cord and/or to the brain. Often multiple placements are needed to achieve the best results. The earlier treatment is begun after the onset the better the results are likely to be. Treatment may need to be very aggressive with extended treatment times and intensities should be as high as tolerated.
- **Avascular necrosis** - the death of bone tissue due to a lack of blood supply. Also called osteonecrosis, it can lead to tiny breaks in the bone and the bone's eventual collapse. A broken bone or dislocated joint can interrupt the blood flow to a section of bone. The most common bone is the femur (hip), and less so, the humerus, knee, shoulder, and ankle. There are many causes: among them are higher dose longer-term steroid use, autoimmune diseases, trauma and cancers. One of the more common forms is Legg-Perthe's disease. PEMFs have been very valuable in adult hip avascular necrosis and can be assumed to be as, or even more, effective in children, especially when treatment is initiated earlier. Higher intensity PEMFs, applied locally would be expected to be the most effective.
- **Caffey's disease -** infantile cortical hyperostosis, excessive new bone formation, is a bone disorder that most often occurs in babies. Caffey disease is caused by a genetic mutation. Many of these individuals have infections and behavioral disorders. PEMFs can be helpful in dealing with infections by potentially reducing the need for recurrent antibiotics, with local treatment. They may also be able to help with the behavioral issues by treatment of the brain using specific brainwave frequencies from portable PEMF systems.
- **Cerebral palsy/spasticity -** while PEMFs will not cure or reverse cerebral palsy (CP), they can often help with the spasticity associated with this condition, as can be seen with with spasticity with other kinds of central nervous system disorders. Treatment would be applied to the brain

and spinal cord more than locally. Locally affected tissues can be treated locally. Some children do better with whole body PEMF systems combined with treatment to the brain and spinal cord. Higher intensity PEMFs may be needed for the best results.

- **Chiari-I-malformation -** in this very rare condition, the part of the brain that controls coordination and muscle movement, the cerebellum, pushes down through the hole in the bottom of the skull, the foramen magnum. The condition can produce a wide range of problems. PEMF therapy will not reverse the condition may be able to help with specific symptoms. Local PEMF treatment would be the first course of action.
- **Chronic postsurgical pain -** PEMFs can be very helpful leading up to surgery to help with the tissues to recover better from the surgical procedure. Chronic pain following surgery often involves chronic inflammation or the trapping of nerves in the tissues recovering from the surgical trauma. The same approach to this type of pain would be used as with chronic musculoskeletal pain.
- **Erythromelalgia (EM) -** an uncommon condition characterized by skin redness, increased skin temperature, and burning pain, mostly in the lower extremities. Pain is often very severe and treatment can be extremely challenging. Causes include increased blood flow, microvascular shunting, increased local metabolism, and small fiber neuropathy. Because pain in EM may be worsened by increased increase circulation, PEMF treatment should be applied to the tissues above the area of the EM or to the spinal cord, using higher intensity PEMF systems. If applied to the local tissues, low intensity, very low, single frequency PEMFs would be recommended.
- **Inflammatory bowel disease – IBD - (Crohn's disease, ulcerative colitis) -** PEMF therapy for IBD can be extraordinarily helpful and would need to be used daily, usually through a person's lifetime. The role of PEMFs is expected to be to reduce pain, inflammation and complications related to fistulas. Regular use throughout the course of the condition would be expected to reduce the need for surgery and medications. The dose of medications may be able to be reduced when combined with PEMF therapy. A critical aspect of managing IBD is to remove potential offending causes such as food sensitivities.
- **Irritable bowel syndrome (IBS) -** the pain and bowel function changes of chronic IBS may be helped significantly with the use of PEMFs, applied to the whole abdominal area. Daily use would be recommended or use of intense treatment during episodes of flares.
- **Juvenile rheumatoid/idiopathic arthritis (JRA/JIA) -** routine use of whole body PEMFs is recommended to reduce flares, limit joint damage, reduce pain, and improve function and mobility. Medications traditionally used for JRA may be able to be reduced or eliminated with routine use of PEMFs.
- **Cancer -** use of PEMFs in cancer is considered to be complementary to improve recovery from therapies, reduce the dosing of medications or side effects and maintain stability, as well as decrease the risk of metastases.
- **Muscular dystrophy (MD) –** PEMFs will not reverse the condition but will help improve the ability of muscle to function, increase strength and stamina through effects on ATP and stimulating muscle fiber function. It's possible, although there is no evidence at this point, that it may be able to slow the progression of MD.
- **Progressive neurodegenerative/metabolic conditions incl. mitochondriopathies** - PEMFs have been found to be very helpful for neurodegenerative conditions, including trauma, by limiting

inflammation and improving physiologic function. PEMFs have been found to increase ATP production and mitochondrial function.

- **Sickle cell disease -** PEMFs are unlikely to reduce the genetic cause of sickling, but, they may be able to decrease the rate of sickling, sludging of the blood, clumping of red blood cells that leads to the vascular obstruction (ischemia), that leads to chronic pain, restoring circulation and increasing oxygenation of affected tissues. It is recommended to use whole body PEMFs, since the entire vascular system is involved. Higher intensity local PEMFs may be used for specific areas of ischemia, to improve circulation as well as reduce the dependency on pain medications, especially opioids. Lifetime use of PEMFs will be needed. It is best to be using PEMFs early in the condition before sickle crises occur.

The above is just a sampling of the potential conditions for which PEMFs may be useful in children.

Preventive PEMF use in children

Daily preventive use of PEMFs in children is probably not necessary unless there are chronic health issues. PEMFs are not expected to enhance normal growth, function or intelligence in the absence problems. Preventive higher intensity PEMF use especially is not recommended routinely in children without health issues. While unlikely, there is some slight risk of overstimulating tissue processes that are in constant flux and constantly balancing themselves anyway, especially over bone growth plates. Probably the most common use of PEMFs in children will be for sleep issues. Because of the known safety of PEMFs, when there are significant health issues, a trial of PEMFs may certainly be recommended to see what the benefits might be.

Symptom management versus tissue or disease management.

While many of the conditions listed above are related to specific diseases, children with chronic symptoms that impair function or quality of life may benefit from PEMFs. As mentioned, PEMFs may help with symptoms, physiologic functions as well as tissue repair and regeneration. Because of their safety, even symptoms, related to physiologic dysfunctions, may be significantly improved, for example sleep, recurrent abdominal pain and colic.

Summary

PEMFs have been significantly underutilized and underemphasized as useful in children. Because of their safety and effectiveness, PEMFs may have a significant role in the treatment of numerous health conditions in infants, children and adolescents. A “go low and slow” approach is recommended, preferably with lower intensity whole body or higher intensity local PEMF systems being used most often.

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