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## Stimulating Bone

Bone turnover and healing is achieved through the action of the Osteoclasts which take up old bone and the Osteoblasts which lay down new bone. These cells respond to electric fields that are generated by the bone itself. Bones have piezoelectric properties. In a sense, a single bone acts like a complex piezoelectric crystal generating an electric field with lines throughout the bone in response to the pattern of stress on the bone. This stress is generated by the attachments of tendons and muscles as well as the articulations of bones with each other. Compression, bending and tension forces all work together to form the electric fields that tell the Osteoblasts where to position themselves to lay down new bone to strengthen the bone overall. This intrinsic electrical stimulation comes from normal daily activity and exercise. Studies have been done to document the effect of complete rest on young healthy male subjects age 21. The subjects were placed at complete bedrest, not allowed to even sit up and their calcium metabolism was monitored. Within 3 days the subjects consistently showed a significant outflow of calcium from their bones and excretion in the urine. This illustrates the important and basic mechanism of the natural electric stimulation of the Osteoblasts in their deposition of new bone. Osteoclast activity continues at a steady pace unaffected by physical activity whereas Osteoblast activity virtually stops without the electrical stimulation of physical activity. The MicroVas electrical stimulation mimics these electric fields and stimulates the Osteoblasts.

The use of bone electric stimulation has been used for years by Orthopedists to accomplish bone healing in difficult cases. The primary method has been to implant a small wire electrode into the fracture area, place a collector pad or anode on the skin and apply a small voltage current generated by a battery to the circuit. This constant galvanic current stimulation then is effective to accelerate bone fracture healing and prevent non union. MicroVas can do this as well and does not require implanting a wire, rather it requires placing pads on opposite sides of the affected body part and the electric field forms between the pads.

The natural electric fields formed by the bones tend to be aligned parallel to the long bones in the body whereas the electric fields generated by the MicroVas unit tend to be perpendicular to these since they are generated by pads placed on opposite sides of the limb. The MicroVas electric fields are much stronger than the natural bone electric fields. So the question is, is this helpful or not? Observations of the effect are that the MicroVas electric fields powerfully stimulate Osteoblast activity increasing calcification and bone deposition. What about the fact that the generated fields are perpendicular to the natural fields in the bones? It would be ideal to be able to generate an electric field that perfectly mimicked that which is generated naturally in the bone. Unfortunately this is impossible because the forces on the bone are complex. The electric fields generated by MicroVas tend to cause a general non directed, non specific increase in bone density in the area. When MicroVas treatments are combined with appropriate natural stresses on the bones from physical activity however, the best outcome occurs. Increased bone is deposited in a more efficient manor resulting in a healing and remodeling in the bone that often simulates what a younger healthier person would experience. Combining MicroVas treatments with physical activity is not always possible however. Many types of cases require casting or fixation to prevent all movement at the fracture site. In these cases the MicroVas treatments greatly improve healing rate and response because the immobility stops the natural electric fields generated in the bones as



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well. MicroVas can be helpful in managing essentially all cases of traumatic fractures and stress fractures and cases at risk of delay or non union as well as fractures complicated by the patients poor health, severe comorbidities, catabolic state or poor vascularity.

In most cases where fractures fail to heal or result in non-union it is the result of one of these three reasons;

1. The blood supply to the fracture site is inadequate.
2. There is too much movement at the fracture site.
3. The patients health is poor and their ability to heal is severely compromised.

The blood supply to a portion of the bone may be lost when the bone is fractured and the only nutrient artery to the bone is on the other side of the fracture. An example of this situation would be a mid body fracture of the Scaphoid bone in the wrist. This is usually managed with complete and possibly prolonged immobilization. There is usually some bone death and resorption while a callous is formed at the fracture site and capillaries and arteries are being regenerated. If there is much bone resorption a deformity of the bone will result causing a chronic arthritic condition and loss of function. Because MicroVas increases blood flow and oxygen in the tissues (as discussed elsewhere) as well as accelerate callous formation at the fracture site, MILD MicroVas treatments (strong enough to stimulate the bone and circulation but not strong enough to cause muscle contraction to the point of movement at the fracture site) can be used with immobilization to minimize bone death and the consequent loss of function. Legg-Perthes disease is a similar condition, as well as many others, that can have an improved outcome with the addition of MicroVas treatments.

Fracture care perhaps is mainly the domain of the Orthopedist, but the Family Practitioner has occasion to see many other medical conditions with bone involvement. Many of these conditions have as their underlying problem poor circulation. This is especially true in the legs. The blood supply may also be compromised regionally to the area in cases of arterial disease and blockage. Diffuse small vessel arterial blockage in the lower legs would be an example. A bone condition may not heal as a consequence of the hypoxia in the tissues. MicroVas can help fractures and other bone conditions heal under these conditions because of the stimulation to the bone in combination with the improved oxygenation in the tissues.

The third reason stated above is poor health in general that causes the patient to not heal. The causes are many including Diabetes, sedentary state, catabolic state, nutritional deficiencies, advanced age and many other co-morbidities. Of course these underlying conditions must be addressed and reduced or controlled as much as possible. MicroVas treatments in combination with standard accepted care for the condition can often be the factor that tips the balance in favor of healing. Here is an example of an actual case; An elderly diabetic female fell and suffered a compound and comminuted fracture of the Tibia and Fibula 3 inches above the ankle. She underwent surgery and had the bones repaired with plates and screws. Post operatively she did not heal and the surgical wound over the compound fracture area turned into an open non healing wound. At 12 weeks there was no sign of callous formation or calcification in the bones including a spiral fracture of the Tibia. The patient was told there was nothing more that could be done for



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her. Fortunately she then started MicroVas treatments which improved the circulation, promoted healing and closed the wound. The fractures healed and calcified properly. She then underwent a second surgery removing the hardware after which she healed quickly and has been ambulatory since.

In addition to the electrical stimulation, Osteoblasts are stimulated to lay down bone by tissue growth factor TGF-2. This hormone is regulated by Human Growth Hormone which is increased through exercise, both aerobic and weight training. Osteoporosis is a condition of generalized loss of calcium from the bones. It has been known for decades that exercise is the most important factor in the prevention of Osteoporosis. Part of the cause for Osteoporosis is a chronic low Human Growth Hormone state over many years. When a patient exercises and gets a MicroVas treatment in the same day the bone is stimulated to heal in two ways, the direct electrical effect of the treatment, combined with the release of HGH during sleep the following night. This is another way exercise enhances the response to MicroVas treatments. In all cases, unless immobility is required, some form of exercise program with a focus on the affected area being treated should be done in combination with MicroVas treatments if possible.