Static Magnetism versus Pulsed Magnetic Therapy in Medical and Veterinary Use

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This article is written to try to answer some of the questions posed about the efficacy and use of static magnets versus pulsed magnetic fields in both medical and veterinary use.

Magnetism is a product of moving charged particles. This can be within a conductor, such as a length of wire carrying an electric current, or found around certain types of materials where the crystal structure is such that a current is formed by electrons, sharing the orbits around the atoms making up the structure in an orderly direction. In a conducting wire a source of energy, i.e. a battery, is required to sustain the flow of electrons in order to overcome the natural resistance, whereas in a magnet, electrons freely orbit their atomic crystal structure, unaffected by any resistance. The flow of electrons in a magnet requires no external input of energy but the field produced is constant and as such has no dynamic component and is therefore not a source of energy in itself. When a constant flow of electrons through the wire is sustained, then the fields produced are identical in nature between the static magnet and the 'induced' field.
Pulsating magnetic fields differ in that they rise and fall around the conductors or coils as the current through them is varied.
Static magnets are widely available for use in both the medical and veterinary fields with many claims made for their efficacy, but are such magnets of any real use? How do they work and where and when should they be applied?

From a purely physics point of view, any effect from magnetic interactions with soft tissue or bone requires a dynamic component. If a static magnet is brought into close proximity to a conductor, i.e. a piece of wire, then there is only an effect whilst the field or the wire are in motion relative to each other, i.e. an electric current is established during this dynamic period. Soft tissue is made up of billions of cells each of which is surrounded by a semi-permeable membrane. Through this membrane pass certain types of ions known as 'cations', which flow into the cells, and 'anions', which flow out. These different types of cations and anions provide the essential nutrients to sustain each cell to perform its designated function. These flows of ions constitute small electric currents in their own right, driven by a small charge that gives a similar effect to having a battery applied across the membrane. The flow of ions would produce a miniscule but virtually undetectable magnetic field. If cells are damaged by accident or disease then the 'battery' that drives the cell's currents may be reduced in its ability to sustain the flow of ions and hence the cell either is reduced in its function, or dies.

Magnetic fields applied to the area of injured cells need some dynamic interaction to have an effect on the anionic and cationic flows across their membranes. Since a magnetic field is a product of moving ions or electrons, then a dynamic field applied externally will have the effect of inducing movement of ions. The generation of electricity is based on this principle. If the generator is stationary and the armatures not in motion, then no electricity is produced. When the armature rotates, electricity will be produced.

Manufacturers that claim to have static magnets which can mimic the motion of pulsating magnetic fields are, therefore, making untrue statements since the magnetic fields, however shaped by positions of other static magnets, will never have a dynamic component. If they could achieve such dynamism from a static source then the world's energy and pollution problems would be solved.

So are static magnets of any real use? Well perhaps the dynamic interactions may come from within the soft tissue itself. If a static field is applied to an area of injury then several possible factors may induce ionic movement. These are:

* Thermal agitation, - under normal conditions soft tissue is fluidic in nature and there may be some Brownian motion i.e. random vibrations of cells due to heat. These slightly moving cells may cut across the static field and as such aid some ionic movement through their membranes.

* Pulsating vibrations, - from the heart as blood pulses through the tissue.

* Muscle twitch - since muscles are never completely static, a magnet attached loosely to an affected area may interact this way. Normal muscular motion will also contribute to this effect.

Since the interactions are very small and inconsistent, it follows that static magnets would need to be applied over a long term in order to achieve any benefit. This contrasts with pulsating fields that, by their very nature, interact as they rise and fall, cutting through the cells and aiding ionic flow. The frequencies at which the fields switch are also an important factor affecting different cells and conditions.

Other claims arise as to the question of the significance of magnetic polarity. Different effects from the north pole of a static magnet are claimed as opposed to the effects produced by the south pole. This has to be viewed with some skepticism, since a magnetic field is formed around the flow of ions or electrons causing it. This makes, in effect, a continuous field loop. The terms *north* or *south* pole indicate which end the magnetic field appears to orientate itself. Since magnetic field poles either oppose or attract each other, depending upon their orientation, they tend to be given a perceived direction although no movement actually occurs. Where this direction of the field appears to emerge from the magnetic material then this is termed the north pole and where the field appears to re-enter the magnet this is the south pole. It follows therefore that at any position along the line of the field there is a north south orientation. Where it appears to come from is the north, where it flows to is the south'.

If we apply the above logic to the case where a static field is applied to the skin surface, the field forms a continuous loop from which there is no net outflow. That entering the skin surface exactly equals that leaving it. If entering the skin, the field is taken as north on the outside, south on the inside, then as the field loops around and emerges from the skin, the north pole could now be said to be on the inside of the skin surface and the south on the outside. Since the net polarity effectively cancels out it is difficult to justify any claims for polarity.

Claims for the existence of monopole magnets and their increased efficacy are in the realms of 'Pseudo Science'. A magnetic field is established around a flow of charged particles. The field orientation is as discussed above. The idea that somehow there could be only one polarity is a physical impossibility. The magnetic field emanating from the north pole of a magnet or coil is part of a continuous loop that cannot exist in an incomplete form. Such devices are a physical impossibility therefore the claims attributed to them are invalid.

Another claim made about static magnets is that of ‘magnetic energy’. This is given the terms positive and negative with the north-south orientation. North pole is said to have negative energy and the south pole to have positive. To understand what energy is we have to look at its definition. Energy simply means ‘the ability to do work’. How can this simple statement be applied to magnets? If energy is divided into its basic components it either exists as potential (stored) energy or as kinetic (dynamic) energy. Static magnets have neither potential nor kinetic, as explained previously. The only way any magnetic induction effect can be derived is by interacting with an external dynamic source of energy. Energy can therefore only be taken out of a system if it has been put there beforehand. Magnetism existing as negative or positive energy becomes meaningless in this context.

Pulsed magnetism requires that energy be put into the system to establish the magnetic field. When the source of energy is removed, the field collapses back into the wire. Used therapeutically, it is during the time that the field is being established or collapsed that energy is being used to drive cellular ionic flows. In other words, this is only during the dynamic periods. There is no concept of negative or positive energy that can be applied since the moving field causes ionic flow dependent upon the direction, angular interaction and electrostatic charges of the ions. The nature of cell membranes is such that they will generally only allow the cations to flow inwards and the anions outwards. The dynamic magnetic field has in effect a push-pull action on ionic flow, aiding both inward and outward movement of ions as it rises and collapses through the membranes.

In writing this short article I have not made reference to, or quoted, specific research. There are volumes available to those interested in a deeper study of therapeutic magnetism. But also, there are many reports of successful usage that are anecdotal rather than scientific in nature. I would suggest that these ‘successes’ are often the only ones reported but failures do not get a mention. In evaluating recovery, we should also not overlook the body’s own ability to help itself under certain conditions. Placebo effects are known to work in at least 25% of cases and as much as 50% are also possible. With animals, the placebo effects are generally missing. However a case was reported to me about racing greyhounds. These seemed to improve their performance over a period of a few weeks from the onset of treatment with pulsed magnetic therapy. It was later found that the magnetic field applicators were faulty and the device had never functioned correctly. The ‘improvement’ of the animals may have occurred because the trainers had expected them to and possibly treated them differently to normal.

Pulsed magnetic therapy used in the correct manner, where the correct frequency and pulse rate is selected, can be a useful aid to treatment of a variety of conditions. The use of static magnets is harder to justify scientifically, but may have some place, although limited, when applied over long periods of time.