

"ELECTRICAL STIMULATION OF THE FEMORAL NERVE IN THE CAT"

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Because of the ever-increasing use of functional electrical stimulation in many patients the need for implanted electrodes instead of surface stimulation, has been grown also in our country.

With the purpose to study the long term effects of electrical stimulation with an implantable system, an animal experiment was set up.

Special attention was given to the histological features of nerve and muscle before and after stimulation. Twelve adult cats received a bipolar electrode made of platinum, placed around the femoral nerve in one leg. A radiofrequency powered stimulator connected with the electrode was implanted in the muscles of the back. The electrode lead ran subcutaneously to the electrode. A special constructed cage, with a built-in antenna in its wall, permitted the delivery of radiosignals to the animal everywhere in that cage. A transmitter outside the cage had the possibility to adjust the time, intensity and frequency of the stimulation pulse and the interval of the stimulus. The animals were stimulated during an hour once a day. The intensity of the pulse was two times the threshold value with a pulsetime of 200 microseconds, this intensity varied from animal to animal between 200 and 400 micro Amperes. The pulse frequency was 30 Hz. The stimulus was on for 2 seconds and off for 28 seconds.

Before and during the experiment threshold value and contraction strength were registered. Muscle biopsies were taken from the unstimulated muscle before and the stimulated muscle after the experiment, to look if fiber composition had changed in course of time. Stimulation took place during 3-16 months. In three cases stimulation ceased to give a response after 5, 6 and 11 months. At operation two electrodes appeared to be dislocated with respect to the nerve. The other electrode had its normal position but histologic examination of the nerve showed a considerable degeneration and signs of chronic infection, probably due to mechanical irritation or compression of the nerve in the electrode.

The threshold value of the nerve initially increased just after implantation but stayed then on its level till about 6 months. After that period a slight increase again could be seen.

Contraction strength of every individual animal displayed great variability but the progress in time was the same in all cases namely initially an increase of about 25% of the original strength. After 6 months however there was a decrease in strength till the original level. An explanation for this phenomenon could be: first an increase as an effect of training and later on a decrease due to the increase of the threshold value of the nerve.

Histological examination of the nerve showed an abnormality in only 3 animals. As above mentioned in one case stimulation was not possible anymore after a sudden increase of threshold value to 500 microampere. This nerve showed severe degeneration. The two animals showed in their nerve samples moderate degeneration, although there was no diminishing response to stimulation. The

only difference with a normal nerve in the other cases, was the amount of collagen in the endoneurium and signs of some chronic irritation in the epineurium.

In muscle biopsies taken from the upperleg muscle before and after stimulation muscle fiber composition was studied by histochemical staining methods.

The size of all fibers did not change in the stimulated muscle. There was also no change to be seen in the distribution of the fast twitch and slow twitch fibers.

Although some investigators found in their experiments a shift in fiber pattern induced by the kind of electrical stimulation we think that in our experiments the period of electrical stimulation was too short to influence the excitation rate of the motorunits. Also our animals kept their normal gait and movements when not stimulated, because of the intact central and peripheral nervous system.

The conclusion of this experiment is that electrical stimulation with the described methods on the intact nerve and muscle, will give no disfunctioning nor change the contraction pattern of the muscle so that this kind of stimulation can be fulfilled for a long period.