

# Functional electrical stimulation (FES) in equine rehabilitation: Initial observations

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## Abstract

This retrospective study reviews the novel use of functional electrical stimulation (FES) in equine rehabilitation as a treatment for muscle spasms, atrophy and asymmetry for both chronic and acute injuries. Approximately 275 horses were treated with FES over a period of 14 years, for a total of over 1900 treatments. Deep chronic epaxial muscle spasms were the primary reason for treatment (95%) with almost 80% of these horses improving by one degree of spasm after 2 treatments. Atrophied muscle showed improvement in palpable size after 4 treatments in 90% of the horses. FES can be used to control the level of muscle and joint movement so that the risk of overuse is limited, which is a major problem in equine rehabilitation. In addition, horses are extremely compliant to the application of FES.

**Keywords:** functional electrical stimulation (FES), horses, equine, rehabilitation, early mobilization

## Introduction

Appropriate mobilization is a well-documented means to improve the outcome of rehabilitation in people after injury or surgery. In equine practice, it can be difficult to obtain the specific and repetitive movements required for effective mobilization especially in the early stages of healing. Horses are not always easy to handle, particularly when their exercise is limited. Therefore, long periods of stall rest are common recommendations in equine therapy.

The benefits of FES in human rehabilitation are well documented in the literature and have been shown to reduce atrophy, decrease muscle spasticity, reduce inflammation and scar tissue, re-educate muscle function, and strengthen muscles and tendons.<sup>[1-4]</sup> FES use in equine rehabilitation has several interesting applications that other modalities cannot provide.

First, in a quality rehabilitation program, both slow- and fast-twitch muscle fibers must be activated early in the protocol. However, in equine rehabilitation the risk of reinjury is greatly increased when speed is added because of the difficulty in precisely controlling speed parameters with horses. FES has been shown to either reverse the recruitment order, or produce simultaneous recruitment of fast- and slow-twitch fibers.<sup>[5-7]</sup> For rehabilitation purposes in horses, the ability of FES to recruit the fast-twitch fibers early in the therapy may prove to be a significant benefit to quality healing.

Second, FES can be used in humans to stimulate deep muscle tissue and therefore strong muscle contractions are possible which are more effective for reducing pain and the benefits are longer lasting.<sup>[8,9]</sup> When FES is used on horses, the deep muscles can be stimulated resulting in strong contractions and more sustained benefits.

Third, safety is an important issue when utilizing rehabilitation modalities and research has shown FES to be safe even for long-term use with denervated muscle.<sup>[10]</sup> In addition, the horses accept the treatments well and remain calm.

The purpose of this retrospective study was to evaluate the data collected during FES treatments on horses, and to determine if FES may be a useful modality to improve healing rates and the quality of the repair. In addition, the parameters for use of FES in equine rehabilitation may offer an interesting extrapolation to human rehabilitation.

## Materials and Methods

Over a period of 14 years, FES was used in over 275 horses for the treatment of muscle atrophy, spasms and asymmetry. Approximately 1900 FES treatments were given over that period of time and records were logged for each treatment to every horse. Ultrasounds during select FES treatments showed that the dorsal spinal muscles were being stimulated including the multifidus and psoas.

The FES system used was the FES310<sup>a</sup> and provided a pulsed, biphasic, rectangular waveform at 60Hz. The voltage applied to elicit contractions ranged from 3.8 to 11V and the treatment time for every treatment was 35 minutes. Six surface electrodes placed in a pad were used to transfer the FES signal to the horse. The skin was sponged with water and ultrasound gel was used between the pad and the skin to reduce impedance.

Descriptive statistics were used to analyze the data and explore the results of the study. The majority of the treatments (95%) were for muscle spasms and muscle atrophy in the epaxial muscles of the horse with the majority of these treatments being for sacral/ilial and lumbar pain (92%). Other areas of initial pain identification included; gluteal, thoracic, neck, shoulder, tarsal and patellar. The horses were almost all riding horses between 2-26 yrs of age.

To evaluate the degree of the muscle spasms and to grade the changes observed after the FES treatments, the Modified Ashworth Scale was used.<sup>[11]</sup> This scale worked well for the author as an objective means of evaluating the initial degree of spasm and to document the changes observed after FES treatments. Photographs were also taken of many of the horses before and after FES treatments.

Evaluation of the changes in atrophied muscles was more difficult due to the difficulty in measuring the circumference of the muscles treated. Palpations of the muscle and photographs were taken pre and post treatment to determine the changes seen.

## Results

About 50% of the horses in the study received a minimum of 5 treatments and almost 30% of the clients continued with serial FES treatments for more than 10 treatments. The length of time the horses underwent FES treatments varied from 2 days to 6.5 yrs. Forty percent of the clients continued with the FES therapy for longer than 6 months.

During the initial observation, palpation was used to determine the grade of the muscle spasm based on the Modified Ashworth Scale. Almost 50% of the horses were rated at Grade 2, indicating a high level of muscle spasm although minimal spinal movement was

possible. In addition, visual examination of the horse's movement and evaluations by the rider and/or trainer were recorded.

Almost 80% of the horses improved by one grade of spasm after 2 treatments, and an additional 14% of the horses showed a change in one grade of spasm after 3 treatments. During this time, none of the horses had any additional interventions, including joint injections, chiropractic or acupuncture treatments, or nutritional changes.

Sustained improvement was determined to be an improvement in one grade of spasm, which was then maintained for a minimum of 2 mo. Almost 60% of the horses showed sustained improvements with the FES treatments when 5-9 treatments were given.

The atrophied muscles required an average of 4-6 treatments to obtain a palpable and noticeable change in muscle size in 90% of the horses. The number of treatments to obtain a sustained improvement of over 2 months was 5-11.

## Discussions

Evaluation of the retrospective data of this study showed that improvements in the dorsal spinal muscle spasms and atrophy of the horses happened quickly. In most horses with muscle spasms, an one-grade change was seen after 2 FES treatments. Atrophied muscle took longer to respond and averaged 4-6 treatments before a palpable and visual improvement was seen. This rapid improvement was probably due to the chronic state of the muscle spasm and atrophy in most of the horses, therefore the change was dramatic at the beginning of the treatments. However, it took several more follow-up treatments, typically 5-11, before the improvement was sustained for over 2 months.

The FES treatments were typically tried on the horses after other treatment methods and modalities had failed. Since this is new technology for the equine industry, most practitioners are skeptical of the usefulness of FES. However, clients are overall pleased with the results for their horses and about a third of the clients in this study had 10 or more treatments performed. The clients determined that FES was helpful in resolving the initial problem of their horses, and the continued use of FES made the horses more comfortable and helped to avoid further injuries.

Serial FES treatments also improved the overall symmetry of the horses. Almost all of the treatments were performed bilaterally with the electrodes being placed symmetrically on each side of the spine. The riders noticed that the horses were more symmetrical under saddle and they related this to the improved performance of their horses.

A limitation of this study was that the information was initially gathered as treatment notes, rather than data for a predesigned study. In addition, the author performed the evaluations of the horses, however the attending veterinarians were also in agreement that the improvements were notable. Another limitation of the study was that the Modified Ashworth Scale used for human rehabilitation was used for the horses, however the author found the scale to be useful.

## Conclusions

This retrospective study shows that the use of FES to decrease muscle spasms was useful in almost 80% of the horses after only 2 treatments. Atrophied muscle showed a palpable improvement in size after 4 treatments in 90% of the horses. The horses responded well to the treatments and even the deep epaxial muscles of the horse could be

reached. In addition, a sustainment of the treatment results was obtained for a minimum of 2 months in over half of the horses treated. Client satisfaction was high with almost 30% of the clients continuing with 10 or more treatments after the initial injury was resolved, because they felt the treatments offered a performance enhancement to their horses. FES can be an effective modality for treatment of muscular problems in horses, however it is not extensively utilized.

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