Chattanooga® VMS Waveform

White Paper

Abstract

Within the evolving landscape of neuromuscular electrical stimulation, the significance of selecting the appropriate waveform is paramount. Variable Muscle Stimulation (VMS™), a proprietary waveform available only in Chattanooga electrotherapy devices, has recently garnered increased attention due to its demonstrated benefits over other waveforms. This white paper aims to elucidate the advantages of VMS™ electrical muscle stimulation in comparison to alternative waveform choices.

1. Introduction

Neuromuscular electrical muscle stimulation (NMES) has been employed for decades to attenuate atrophy, increase muscular strength, and improve muscular performance. The ability of NMES to induce physiological effects is influenced by various factors, including current type, pulse duration, frequency, and notably, waveform. While several waveforms such as Russian, biphasic, and monophasic have been traditionally utilized, VMS offers many physiological advantages which could contribute to more effective patient treatments.

2. Basics of VMS

VMS™ (Variable Muscle Stimulation) refers to the specific type of waveform that utilizes an optimized symmetrical biphasic waveform. While the frequency of this waveform is adjustable, it is comprised of biphasic pulses with adjustable phase duration and 100μs inter-phase intervals. This waveform can either be delivered continuously or in bursts (VMS-Burst™), depending on therapeutic goals and target tissue. This alternating charge pattern provides increased muscle contraction forces, improves patient comfort when eliciting equivalent contractile forces, and provides decreased skin reactivity.

3. Benefits of VMS Over Other Waveforms

3.1 Increased Muscular Contractile Forces: VMS employs an adjustable phase duration and fixed interphase interval that has demonstrated increased muscle torque with tolerable discomfort (1). The augmentation in contractile force elicited by this waveform, concomitant with decreased patient discomfort, can be attributed to two key factors: the inherent characteristics of the square wave pattern's alternating charge polarity, and ability to tailor both amplitude and phase duration to specific patient or target muscle needs. Specifically, the shape of the square wave enables peak contractile signaling for the entire pulse, as opposed to sinusoidal waveforms which have ramping periods that only briefly generate peak contractile signaling. This difference in waveform shape necessitates that sinusoidal waveforms (e.g., Russian Stimulation) apply increased peak current to generate equivalent muscular contractile forces, which leads to decreased patient comfort (2).

3.2 Reduced Fatigue: The biphasic pattern of VMS results in reduced muscle fatigue when compared to constant high-frequency waveforms (3). By providing optimized interphase intervals without stimulation, the muscle is allowed intermittent micro-rest periods, decreasing the accumulation of metabolic byproducts that lead to fatigue.

3.3 Enhanced Circulation: The rhythmic contraction and relaxation induced by VMS can enhance blood circulation in the stimulated area (4). Improved blood flow can aid in the removal of metabolic waste, thus assisting in muscle recovery post-exercise or post-injury.

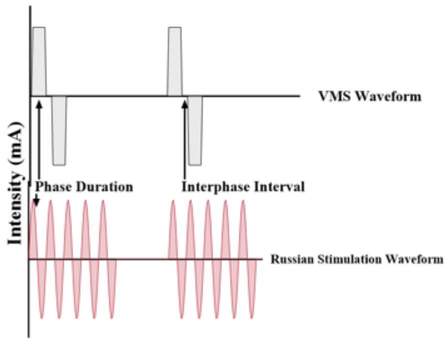

Figure. Representative VMS and Russian Stimulation waveforms. Of note, the square shape of the VMS current as compared to the sinusoidal signal of Russian Stimulation.

4. Comparative Limitations of Other Waveforms

4.1 Russian Stimulation: While effective in generating muscle contractions, Russian stimulation, with its continuous 2,500Hz carrier frequency, can rapidly lead to muscle fatigue (3). However, multiple studies have demonstrated symmetrical biphasic waveforms generate significantly increased maximal voluntary force when directly compared to Russian Stimulation, both in IFC, VMS, and VMS burst currents (2, 5). Of note, the symmetrical biphasic waveform parameters employed by VMS have demonstrated significantly increased torque without imposing intolerable discomfort as compared to parameters employed by other types of symmetric biphasic waveform devices (1).

4.2 Biphasic and Monophasic Waveforms: Biphasic waveforms, although safer in terms of reduced risk of skin burns, may not be as effective in producing deep muscle contractions. Monophasic waveforms, while able to produce deep contractions, carry a higher risk of skin irritation due to the unidirectional flow of current (6).

5. Conclusion

In the domain of electrical muscle stimulation, the choice of waveform plays a pivotal role in dictating therapeutic outcomes. VMS, with its unique use of interphase intervals and ability to administer pulses in bursts, offers several benefits over traditional waveforms. Its ability to generate increased muscular contractile forces, reduce muscle fatigue, and enhance local circulation make it an evidence-based choice for both rehabilitation and performance enhancement. As with all medical interventions, it's essential for clinicians to consider individual patient needs and contraindications, but VMS offers a compelling option worth consideration in the realm of EMS.

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