

PHYSIOLOGICAL ACTION TREMOR AS A PRECURSOR **M** SHIVER

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INTRODUCTION:

One of the first overt responses to cold stress is muscle tensing and shivering. Shiver, which is often described as a clonic oscillation or tremor, has a frequency range of 8 - 11 hz with the major frequency at 9 hz (1). Although the physiological basis of this tremor is not well understood, some studies suggest that shiver is an amplification of a tremor which is normally present. The purpose of this paper is to present data to support the concept that physiological action tremor of the hand or ankle can become continuous and resemble shivering in cold stressed subjects.

Tremors can be studied either during maintenance of posture or motion. During maintenance of postures, which is called "rest", tremors of the hand have been studied by monitoring the oscillations from the outstretched hand or finger. Frequencies of 5 - 15 hz with a major frequency of 9 hz was reported for the outstretched finger. This frequency was independent of mechanical loading, since weight added to the finger decreased the amplitude but not the frequency of the finger tremor. This evidence suggested that the servo loop was responsible for the frequency of tremor. Marshall and Walsh measured the tremor at rest at a number of sites on the body and found that the frequency of oscillation ranged from 7 - 12 hz at the wrist, elbow, shoulders, ankle, knee, and hip (2).

De Jong described the tremor associated with movement in paralysis agitans. He called these oscillations "action tremor" and differentiated them clearly from tremors at rest (3). Since that report, tremors associated with movement have frequently been called action tremor. Pozos, Iaizzo, and Petry did a quantitative study of the tremor associated with the slow extension-flexion of the ankle in normal subjects (4). They found that the tremor during movement of the ankle had a frequency range of 4 - 8 hz compared to the frequency of 6 - 9 hz for the ankle tremor during posture (rest). The amplitude of the action tremor was significantly greater by a factor of 2 - 5 times over rest tremor. They called this tremor associated with voluntary limb motion "physiological action tremor" to distinguish it from pathological tremors seen during voluntary muscular contraction. In another study, Pozos and Howard reported on postural and action tremor of the hand. In slow movement of the hand, there was an associated tremor which was different from the postural or physiological hand tremor. Action tremor of the hand had a frequency of 10 hz, and postural hand tremor had a frequency of 7.5 hz. The displacement of action tremor was 20 times greater than postural tremor (5).

One of the distinguishing characteristics of physiological action tremor of the hand or ankle is the distinct bursting associated with the tremor. This amplitude modulation occurs only during certain times of the voluntary extension and flexion of the wrist or ankle.

METHODS:

In all experiments, the seated **male** subject had surface electrodes which were placed on the extensors and flexors of the wrist, or on the tibialis anterior and soleus of the leg. In addition, an accelerometer **was** placed on their hand or on their knee. In the first experiment, to record physiological action tremor, they **were** required to slowly raise and lower their heel or to slowly extend and flex their wrist. In **the** second experiment they were required to run until they were fatigued. At that point they were seated, and then the action tremor of their ankle **was** studied. In another experiment the subjects **were** placed in a cold chamber, and their skin and rectal temperatures were recorded. After five minutes in the chamber they did the same maneuver they had done previously to record physiological action tremor. In the cold chamber it took them approximately 15 minutes before they began to shiver violently. Analysis of the various tremors and **emgs** **was** done **by** spectral analysis.

RESULTS :

The physiological action tremor of the hand or ankle were 8 - 9 hz for the hand, and 6 - 8 hz *for* the ankle. After fatiguing, the action tremor became continuous and resembled clonus. In the cold stressed subjects, the amplitude modulation of the action tremor became more pronounced **and** continuous. This increased in duration until it became indistinguishable from shivering of the hand or of the ankle. The frequency was approximately 6 - 8 hz.

DISCUSSION:

Physiological action tremor is characterized by distinct bursting of the **emg**. **This** amplitude modulation resembles a clonus like frequency. In normal situations, this amplitude modulation is of short duration. During cold stress, this amplitude modulation becomes gradually continuous and is indistinguishable from shivering. These data suggest that the physiological control of physiological action tremor can be altered by various kinds of stimuli. In **some** manner, cold stress eventually is **able** to influence the control of the amplitude modulation **so** as to prolong the duration of the action tremor so that the **body** is **able** to generate additional heat.

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