

## ABSTRACT

**Objective:** To determine whether Archimedean spirals (AS) characteristics are distinct and predictive for psychogenic tremor (PT) compared to organic tremor.

**Background:** PT is often of sudden onset and associated with psychological stressors. The clinical examination often demonstrates distractibility, suggestibility, variable frequencies, and entrainment.

**Design/Methods:** 33 AS drawn by patients with ET (26/33, 78.8%), and PT (7/33, 21.2%) were reviewed to determine the presence of a single axis, whether the single axis fell between 12 and 3 o'clock vs. 3 and 6 o'clock, and if a regular frequency of oscillation occurred.

**Results:** AS with a single axis were present in 18/26 (69.2%) of ET patients, and in 1/6 (16.7%) of patients with PT ( $\chi^2= 6.816$ ,  $p=0.009$ ). Oscillatory errors were regular in ET (16/26, 61.5%), and irregular or absent in PT (5/7, 71.4% and 1/7, 14.3% respectively,  $\chi^2= 6.263$  ( $p= 0.044$ )). The axis orientation of the tremor did not significantly differentiate between ET and PT ( $\chi^2= 0.818$ ,  $p>0.05$ ).

**Conclusions/Relevance:** Archimedean spirals with absent or multiple axis, irregular tremor, or absent tremor in the setting of present postural tremor, are highly predictive of psychogenic tremor. AS drawing is a simple and inexpensive test that differentiates between tremors of psychogenic and organic origin. Further blinded studies with larger samples are needed to validate the sensitivity and specificity of AS as a diagnostic tool in patients with psychogenic tremor.

## INTRODUCTION

Psychogenic movement disorders (PMD) range in phenomenology and may present as tremor, dystonia, parkinsonism and myoclonus. Clinical characteristics that distinguish PMD from organic movement disorders are sudden onset and often spontaneous remission, amplitude and frequency variability, suggestibility, and entrainment, in the absence of neurological signs<sup>1,2,3,4,5</sup>. The presence of coexisting psychiatric illness, such as depression, anxiety, and other stressors may play a significant role in the pathogenesis of PMD<sup>3,6,7</sup>. Tremor is the most frequent PMD accounting for 4.1% and up to as many as 55% of patients<sup>2,5,8</sup>. There are no laboratory or imaging studies that can diagnose psychogenic tremor (PT), rather diagnosis is based on history and the characteristics common among PMD. AS drawing in patients with tremor reveals the presence of oscillatory errors that vary in frequency and amplitude dependant on the severity of tremor. Tremor has been found to be consistently worse in unsupported spiral drawing<sup>9</sup>. An axis with characteristic orientation may be identified in patient with essential tremor (ET)<sup>10</sup>. Frequency variability is present in tremorgrams of patients with PT<sup>11</sup>.

## METHODS

33 Archimedean spirals (AS) drawn by 26 patients with clinically diagnosed ET (78.8%), and 7 with PT (21.2%) were reviewed. The rater was asked to determine the presence of a single axis; whether the single axis fell between 12 and 3 o'clock vs. 3 and 6 o'clock; and if a regular frequency of oscillation occurred. In the absence of a single axis, and/or regular tremor, a diagnosis of PT was assumed. The spirals were then separated by diagnosis and reviewed to reveal the presence, if any, of a pattern distinctive to either ET or PT.

## RESULTS

AS with a single axis were present in 18/26 (69.2%) of ET patients, and in 1/6 (16.7%) of patients with PT ( $\chi^2= 6.816$ ,  $p=0.009$ ). Oscillatory errors occurred at regular intervals in ET (16/26, 61.5%), and were absent (5/7, 71.4%) or occurred in irregular intervals (1/7, 14.3%) in PT,  $\chi^2= 6.263$  ( $p= 0.044$ ). The axis orientation of the tremor did not significantly differentiate between ET and PT ( $\chi^2= 0.818$ ,  $p>0.05$ ). When separated by diagnosis, three patterns emerged. In ET spirals, the oscillatory errors peaked with asymmetry in the ascending and descending slopes (saw tooth pattern) with a clear axis; and in the PT tremors oscillatory error peaks were absent from the spiral, or were rounded and symmetrical in all quadrants (daisy pattern).

ET



PT



## DISCUSSION

While the historical and clinical characteristics of tremor are the mainstay in differentiating essential tremor from that of psychogenic origin, the Archimedean spiral differences may add further information when distinguishing between these two pathologies. Through pattern recognition, spirals may be separated into three groups: spirals without oscillatory errors and no axis, spirals with rounded errors without a clearly distinguishable axis, and spirals with asymmetric peaked oscillations with clear axis. Furthermore, these features statistically differentiated ET from PT spirals when compared separately. The presence of postural tremor in the absence of oscillatory errors on spiral drawing also suggested a psychogenic origin.

## CONCLUSIONS

Spiral drawing is a widely used clinical tool in assessment of tremor. Psychogenic spirals are frequently unusual, with features of absent or multiple axis, and absent or irregular tremor. These characteristics are highly predictive of psychogenic tremor, with the absence of tremor on AS in the presence of postural tremor also highly suggestive of PT. AS drawing is a simple and inexpensive test that differentiates between tremors of psychogenic and organic origin. Further blinded studies with larger samples are needed to validate the sensitivity and specificity of AS as a diagnostic tool in patients with psychogenic tremor.

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