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Finger tremor in alcoholic patients

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Charcot (1889) divided tremor into three categories: slow, intermediate, and vibratile. He included alcoholic tremor in the 'vibratile' category, *i.e.*, it was of low amplitude as compared with Parkinsonian or hysterical tremor, and occurred at 8 to 9 c/sec. Friedlander (1956) detected tremor of the tip of the index finger by means of an electromagnetic technique. He compared the records obtained from 25 alcoholic patients with those from a similar number of control subjects. He found that the mean amplitude of tremor in the alcoholic group was significantly greater than that displayed by the controls. In addition, the alcoholic group contained a relatively high proportion of subjects in whom the higher frequency tremor components, *i.e.*, at 8 to 12 c/sec. and above, were particularly prominent. In the records from two subjects who displayed an obvious tremor on physical examination, activity at 6 c/sec. was abnormally accentuated.

In view of these reports, the objects of the present investigation were as follows: first, to compare the tremor amplitude observed in a group of alcoholic patients with that occurring in a series of normal control subjects, using a precise technique of measurement; secondly, to determine, by means of frequency analysis, whether there was any difference in the relative amplitudes of tremor components at different frequencies in alcoholic patients as compared with normal subjects; and thirdly, since it has been shown by Graham (1945) and by Redfearn (1957) that neurotic or anxious patients display a larger tremor amplitude than normal controls, it seemed important to determine the extent to which the psychiatric history as well as the presence or absence of organic illness should be taken into account in interpreting the results of a study on tremor in alcoholic patients.

METHODS

DETECTION AND DISPLAY OF TREMOR The methods used for the detection and display of tremor have been described in detail elsewhere (Carrie, 1965), and the following is a summary.

A semiconductor strain gauge assembly was used to detect vertical movement of the distal part of the proximal phalanx of the index finger during an extension effort against a load of 50 g. The forearm, palm, and the other fingers were rigidly supported.

The signal from the transducer, which bore a highly linear relation to the amplitude of vertical movement of the finger, was amplified using a DC pre- and main-amplifier, and was used to deflect a spot on an oscilloscope screen which was displayed to the subject. At the gain used, a 0·15 mm. vertical movement of the distal part of the proximal phalanx of the index produced a deflection of this moving spot that subtended an angle of 0·66 degrees at the subject's eye. The subject was required to superimpose the moving spot on a fixed spot on the screen by controlling the vertical movement of the index finger against the 50 g. load. Since each subject was required to maintain the finger in the same alignment with the aid of the visual display during each period of observation, and since movement occurring at only one joint was measured, the mechanical conditions under which tremor occurred were comparable during successive measurements.

MEASUREMENTS The amplified signal was quantified in two ways. 1 It was fed to an integrating counter of the type described by Bates and Cooper (1954), slightly modified so as to give a measure, as a numerical score, of mean tremor amplitude down to low frequencies. The system caused 0·6 db attenuation of the signal at 1 c/sec. 2 The amplified signal was subjected to frequency analysis by means of filters of the type used in the B.N.I.—Faraday low-frequency wave analyser. The signal was applied in

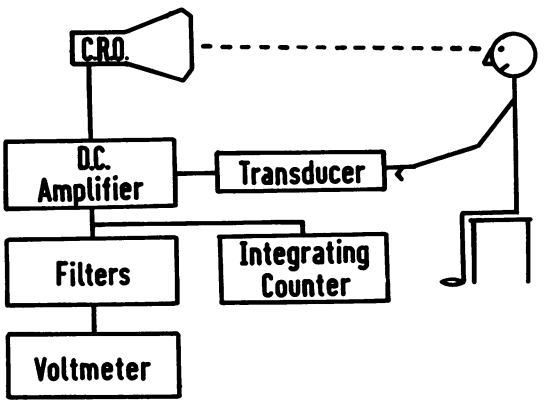

FIG. 1. *Diagram of system used for detection, display, and measurement of tremor.*

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parallel via a compressor stage to the inputs of filters tuned to respond maximally at 1 c/sec. intervals between 2 c/sec. and 12 c/sec. inclusive. Each filter gave 6 db attenuation at $\pm 0{\cdot}5$ c/sec. from its central frequency. The output currents from these circuits were used to charge storage capacitors during a fixed period by the operation of a manual switch timed with a stopwatch. The voltages on the capacitors were then read consecutively on a multirange voltmeter, these charges giving a measure, in arbitrary units, of the mean tremor amplitude at each of the frequencies for which a filter was available during the relevant period of observation.

A diagram of the system used for the detection, display, and measurement of tremor is shown in Figure 1.

PATIENTS Twenty consecutive patients referred to the Maudsley Hospital for the treatment of alcoholism were examined. All the patients were alcoholics in the sense of the definition recommended by the World Health Organization (1952) in that their dependence on alcohol had reached 'such a degree that it showed a noticeable mental disturbance or an interference with their bodily and mental health, their interpersonal relations, and their smooth social and economic functioning'. The fact that the investigation was for research purposes, and was not part of their treatment, was explained to the patients when they were asked to participate. None had taken alcohol in the 36 hours preceding the investigation; in most instances they had not been drinking for seven days. None had received drugs, or undergone any other form of physical treatment at the time they were studied. Eight patients had a history of affective illness in which anxiety had been a prominent symptom. Four patients showed tremor of the outstretched hands, but no other neurological abnormalities were detected at the time of the investigation. Eighteen male and two female patients were studied; their mean age was 45·3 years (S.D. = 8·8 years).

NORMAL CONTROL SUBJECTS The control subjects were 18 males and two females who had a similar age distribution to the patients (mean = 42·6 years; S.D. = 9·6 years). They were mainly members of the medical, technical, and administrative staff of a hospital and research institute.

PROCEDURE Each subject was required to maintain the index finger in a constant alignment with the aid of the oscilloscope display for six 10-second periods of observation during which the integrating counter and the storage capacitors on the filter outputs were switched into circuit.

RESULTS

TREMOR AMPLITUDE The mean score on the integrating counter for the 20 controls was 1,366 units. For the 18 patients who remained after the two who showed a very large tremor amplitude had been excluded, the mean score was 2,568 units. A t test showed that these means differed significantly ($t = 3{\cdot}65$; $p < 0{\cdot}001$).

The average of the scores from the two alcoholics who displayed tremor of exceptionally large amplitude was 12,753 units. Both those patients had histories of emotional disorder. When their scores were excluded, the remaining six patients with a history of affective illness showed a mean tremor amplitude score (3,273 units) which was higher than, and differed significantly from, the control mean ($t = 2{\cdot}95$; $p < 0{\cdot}01$).

Since the patients who had a history of emotional disorder showed a larger mean tremor amplitude than the overall mean for the alcoholic series (3,273 units as compared with 2,568 units), the question arose as to whether the significant quantitative difference between the patients and the controls might be due to the presence among the alcoholics of a number of patients who showed a large tremor amplitude in relation to a predisposition to emotional disorder rather than in relation to their alcoholism. It therefore seemed desirable to compare independently the mean tremor amplitude recorded in the 12 patients who had no history of emotional disorder with that found in the controls. The mean amplitude score for these patients (2,106 units) was higher than, and differed significantly from, the control mean ($t = 2{\cdot}35$; $p < 0.05$).

These results are summarized in Table I.

TABLE I

TREMOR AMPLITUDE MEASUREMENTS

Group	*No.*	*Tremor Amplitude (arbitrary units)*	*p**
Controls	20	1,366	—
Patients with no history of affective illness	12	2,106	<0·05
Patients with history of affective illness with anxiety	8 (6 / 2[1])	3,273 / 12,753	<0.01 / —

p* = comparison with control mean

FREQUENCY ANALYSIS Figure 2 shows the results obtained from frequency analysis. The mean tremor amplitude has been plotted against frequency on a log-log scale. The most striking feature is the similarity of the general shape of the curves from each group. There is a 'hump' in each spectrum in the 6-10 c/sec. range, with a peak at 8 c/sec. in each case. Outside this range there is an approximately equal proportional difference in amplitude at each

[1]NOTE ON STATISTICAL ANALYSIS OF DATA When the tremor measurements obtained with the integrating counter were inspected, it was clear that two of the patients showed tremor of exceptionally large amplitude. As the inclusion of their results would have caused excessive skewing of the data, their scores were excluded for purposes of statistical analysis. Furthermore the scores from the patients showed a larger scatter than those of the controls, and to compensate for the resulting lack of homogeneity in the data, all statistical analyses were carried out after logarithmic transformation of the raw scores.

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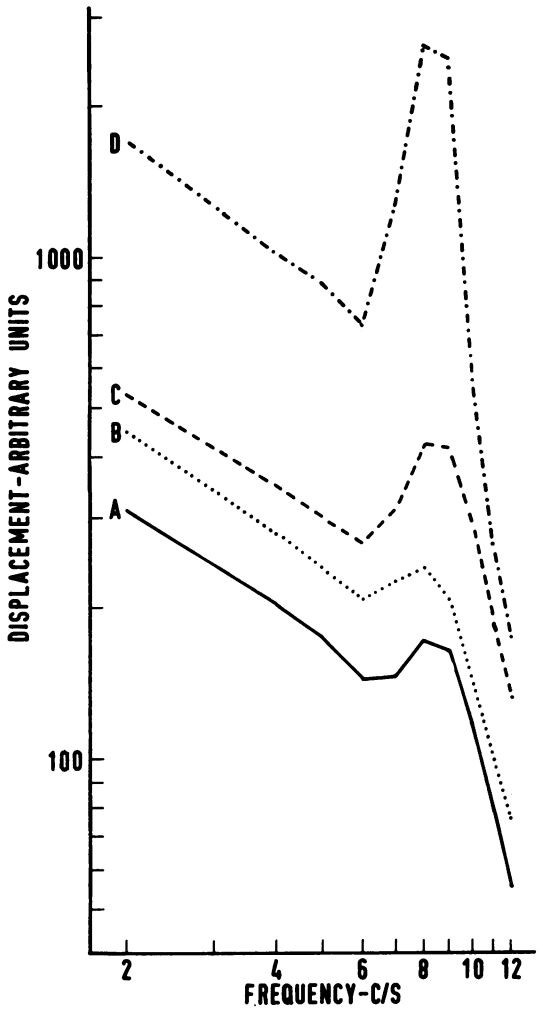

FIG. 2. *Amplitude of displacement of the finger plotted against frequency on a log-log scale. Spectra from below upwards: A, controls; B, alcoholics, with no history of affective illness; C, alcoholics with a history of affective illness with anxiety; D, one of the two patients displaying tremor of exceptionally large amplitude.*

frequency, equal proportions being represented by equal distances on a logarithmic scale.

In view of the previous reports that higher frequency components are particularly prominent in the tremor of alcoholics, an arbitrary quantitative index was developed which allowed assessment of the relative prominence of the components at 7 to 9 c/sec., *i.e.*, the frequency where the peak occurred in each spectrum in the averaged data and the frequency on either side. In calculating this index, the summated ordinates at 7 to 9 c/sec. were divided by the summated ordinates at other frequencies to give a ratio, which was expressed as a percentage for each subject. The magnitude of this ratio gave a measure of the relative prominence of the tremor in the 7-9 c/sec. range.

Table II shows the numbers of subjects who scored more, and who scored less, than 50% in terms of this ratio, in the control group, in the whole series of patients, and in the subgroup of patients who had a history of emotional disorder. Chi-square analyses showed that while subjects scoring more than 50% on this index were significantly more common in the subgroup of alcoholics who had a history of affective disorder than among the controls, this was not true for the whole group of patients.

TABLE II

PROMINENCE OF 7-9 C/SEC. COMPONENTS. DISTRIBUTION OF SCORES ON ARBITRARY INDEX

Group	<50%	>50%	*p**
Controls	17	3	—
All patients	10	10	>0·05
Patients with history of psychiatric illness with anxiety	1	7	<0·01

p* = comparison with control distribution

DISCUSSION

These results confirm Friedlander's (1956) finding of a significantly greater tremor amplitude in alcoholic patients than in normal subjects.

In the present investigation, when alcoholics with a history of emotional disorder were excluded, it was found that the remaining patients displayed a significantly greater mean tremor amplitude than the controls. Thus alcoholism was found to be related to an abnormally large mean tremor amplitude in the absence of any evidence of an associated predisposition to emotional disorder.

Alcoholic patients who had a history of affective illness in which anxiety had been a prominent symptom showed a larger tremor amplitude than the other members of the alcoholic series. As has already been noted, Graham (1945) and Redfearn (1957) found that non-alcoholic emotionally disturbed patients had a significantly larger mean tremor amplitude than normal controls. From the results of the present experiment it is impossible to ascertain the relative magnitudes of the parts played by the two factors, the history of emotional illness and the alcoholism, in the production of the exceptionally large mean tremor amplitude displayed by the alcoholics who had had an emotional disturbance. In order to elucidate this matter, it would be necessary to carry out a similar series of observations on a matched group of non-alcoholic patients with a

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history of emotional illness. However, the results of this study do suggest that the psychiatric history must be taken into account in interpreting observations made on tremor in alcoholics.

The nature of the mechanisms underlying physiological tremor and determining its amplitude is obscure. Various explanatory theories have been proposed, but none are entirely satisfactory (Marshall and Walsh, 1956; Halliday and Redfearn, 1956, 1958; Lippold, Redfearn, and Vučo, 1957; Van Buskirk and Fink, 1962; Brumlik, 1962; Wachs, 1964). The present investigation does not enlarge our understanding of these mechanisms. The findings made in this study can be plausibly explained in terms of any of the various theories of the origin of physiological tremor that have been advanced. However, the shapes of the tremor frequency spectra obtained by averaging the results from all the patients, and by averaging the data from particular subgroups within the alcoholic series, were similar to that seen in the plot of the pooled measurements from the control group. The alcoholics with a history of emotional disturbance showed a relatively greater degree of prominence of the 'hump' in the spectrum at 7 to 9 c/sec., but this was an exaggeration of a feature seen in the control group. It may be, therefore, that the same mechanisms determine the general characteristics of tremor in normal subjects and in alcoholics, though in the latter group their functioning is modified so that the tremor amplitude is increased.

This investigation was carried out on a rather restricted category of alcoholics. No patients with clinical neurological abnormalities nor any who were suffering from an alcoholic psychosis were examined. If patients manifesting such disorders were studied, other types of abnormality might emerge.

SUMMARY

The tremor in the proximal phalanx of the index finger was detected during an extension effort of 50 g. In order to standardize the mechanical conditions as far as possible, the subjects were provided with an amplified visual display of the position of the finger.

Twenty alcoholic patients were studied. None showed significant abnormalities on neurological examination. These patients were compared with a group of matched normal subjects.

Mean tremor amplitude was measured using an integrating counter. The mean amplitude displayed by alcoholics with a history of psychiatric illness in which anxiety had been a prominent symptom was greater than the mean for the rest of the alcoholic group. When compared with the controls, the amplitude displayed by the alcoholics was significantly greater whether or not they had suffered from a psychiatric disorder of this type.

Subjects showing tremor components of relatively large amplitude at 7 to 9 c/sec., as measured in terms of a quantitative index, were significantly more common in the subgroup of alcoholics who had a history of affective illness with anxiety than in the controls, but subjects displaying this feature in their tremor frequency spectrum did not occur significantly more frequently in the whole alcoholic series than in the control group.

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