Published in final edited form as:

J Neurol Neurosurg Psychiatry. 2011 July ; 82(7): 761–765. doi:10.1136/jnnp.2010.229740.

Estimating annual rate of decline: prospective, longitudinal data on arm tremor severity in two groups of essential tremor cases

Elan D Louis^{1,2,3,4}, Angus Agnew¹, Arthur Gillman¹, Marina Gerbin¹, and Amanda S Viner¹

¹GH Sergievsky Center, College of Physicians and Surgeons, Columbia University, New York, New York, USA

²Department of Neurology, College of Physicians and Surgeons, Columbia University, New York, New York, USA

³Taub Institute for Research on Alzheimer's Disease and the Ageing Brain, College of Physicians and Surgeons, Columbia University, New York, New York, USA

⁴Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, New York, USA

Abstract

Background—Despite its high prevalence, there are surprisingly few prospective, longitudinal data on the clinical course of essential tremor (ET). Patients themselves often want to know from their treating physician whether and by how much their tremor is expected to worsen over time.

Methods—As part of two research protocols, prospective, longitudinal data were collected on tremor severity in two samples of ET cases (44+39 cases, combined n=83). At a baseline and one follow-up evaluation, a detailed clinical assessment was performed and action tremor in the arms was rated by a senior movement disorders neurologist using a standardised clinical rating scale (Total Tremor Score (TTS), range 0–36).

Results—In the first case sample, TTS increased annually by 0.32 ± 0.89 points (ie, an annual increase of $5.3 \pm 17.1\%$ (median 1.8%) from the mean baseline score). TTS increased by 0.5 points in 23/24 (95.8%) cases followed for 5 years. In the second sample, TTS score increased annually by 0.64 ± 1.49 points (annual increase of $3.1 \pm 8.1\%$ (median 2.0%) from the mean baseline score). TTS increased by 0.5 points in 11/15 (73.3%) cases followed for 5 years. No baseline factors were identified that predicted annual change in TTS.

Conclusions—Most ET cases exhibited a progressive worsening in tremor scores with time such that the average annual increase in tremor severity from baseline was estimated to be between 3.1% and 5.3% and the median annual increase from baseline was between 1.8% and 2.0%. These published estimates will hopefully be a useful prognostic guide for clinicians and their patients.

Correspondence to: Dr E Louis, Unit 198, Neurological Institute, 710 West 168th Street, New York 10032, USA; edl2@columbia.edu.

Competing interests None.

Ethics approval This study was conducted with the approval of the Columbia University Medical Center.

Contributors The statistical analyses were conducted by EDL.

Provenance and peer review Not commissioned; externally peer reviewed.

INTRODUCTION

Although essential tremor (ET) is one of the most highly prevalent neurological disorders,¹² and is a clinical entity that is commonly encountered both by movement disorder specialists as well as general neurologists,³ there seems to be little agreement as to its clinical course. Hence descriptions span a broad range and include the statement that it is ‘not progressive’⁴ and the conflicting statement that it is ‘progressive’,^{5–7} as well as a full range of statements in between (‘generally mild and non-progressive’,⁸ ‘may be a progressive neurological disorder’,⁹ ‘often progressive’,¹⁰ ‘usually slowly progressive’¹¹ and ‘slowly progressive’^{12,13}).

The question is not merely academic, as it is patients themselves who often want to know from their treating physician whether and by how much their tremor is expected to worsen over time. Despite its high prevalence, there are surprisingly few data that may be used to guide prognosis. Two studies provided cross sectional data; tremor severity was mathematically divided by tremor duration to obtain an estimate of rate of change.^{14,15} However, in these studies, patients were only evaluated at a single time point. Longitudinal data are preferable, yet there are only two such studies, in which 44¹⁶ and 45⁶ ET cases were selected because they were evaluated at more than one time point. Both studies,^{6,16} however, were clinic based. Patients who elect to return for follow-up clinical visits are a self-selected group who often have tremor that is progressively worsening; patients with stable tremor are less inclined to return. Hence these studies are likely to have overestimated the rate of decline in ET.^{6,16} Indeed, one of the studies reported a 12% yearly worsening after baseline in their sample,⁶ which is a sizeable yearly change.

As part of two research studies on ET, we collected prospective, longitudinal data on tremor severity in two samples of cases (total n=83). Cases were not self-selected for follow-up based on a need for clinical care. The goal of this report was to present longitudinal, prospective data on tremor severity in ET, and to generate an estimate of rate of change in ET. We hope these data will be of value to clinicians who are providing general prognostic guidance to their ET patients.

METHODS

Data for these analyses were derived from two distinct samples of ET cases that did not overlap.

Cases enrolled in an epidemiological study of ET

ET cases were enrolled in a research study of the environmental epidemiology of ET at Columbia University Medical Center (CUMC) (2000–2009).^{17,18} By design, ET cases were initially identified from several sources, with the major ones being a computerised billing database of all ET patients who were seen one or more times at the Neurological Institute of New York (CUMC), and advertisements to ET patients who were members of the International Essential Tremor Foundation. All cases had received a diagnosis of ET from their treating neurologist and were confined to a geographic area that was within 2 h driving distance of CUMC in New York, New Jersey and Connecticut.

On enrolment, each case signed a written informed consent form, approved by the CUMC ethics committee. Each case completed demographic and clinical questionnaires and underwent a standardised videotaped tremor examination, which included one test to elicit postural tremor (sustained arm extension) and five tests to elicit kinetic tremor (eg, writing, pouring). Each of six tests was performed with the dominant arm and then the non-dominant arm (12 tests in total).¹⁹ The videotaped tremor examination also included assessments of

voice tremor, head (neck) tremor, jaw tremor and rest tremor. Each videotape was reviewed by a senior neurologist specialising in movement disorders (EDL), who rated the arm tremor during each of 12 tests using a 0–3 scale with established intra-rater and inter-rater reliability.²⁰ Based on the ratings (0, 0.5, 1, 1.5, 2 and 3), a tremor score was assigned for each arm (0–18 (maximum)) as well as a Total Tremor Score (TTS, 0–36 (maximum)). This score has been shown to correlate with other quantitative objective measures of tremor severity, including the score on a 9 hole portable hand steadiness tester ($r=0.68$, $p<0.001$),²¹ the score on a 15 item performance based test (eg, ratings of tremor while threading a needle, using a screwdriver, using a house key, $r=0.71$, $p<0.0001$)²² and quantitative computerised tremor analysis results (maximum amplitude of arm tremor while writing with dominant arm, $r=0.41$, $p<0.001$). Using the clinical questionnaire and videotape data, the diagnosis of ET was re-confirmed in each case using published diagnostic criteria (moderate or greater amplitude kinetic tremor (tremor rating ≥ 2) during three or more activities or a head tremor in the absence of Parkinson's disease).^{19,23}

In April 2009, using random selection, we began conducting follow-up assessments on ET cases. Cases signed informed consent approved by the CUMC ethics committee.

Random selection was used and all such selected participants agreed to a follow-up assessment. To date, we have re-enrolled 44 of 376 cases. These 44 enrollees are similar to the larger group of 376 from which they were drawn in terms of baseline tremor severity (TTS, 18.6 ± 6.6 vs 18.9 ± 7.2 , $t=0.26$, $p=0.79$), tremor duration (26.3 ± 17.8 vs 22.8 ± 18.6 years, $t=1.19$, $p=0.24$) and age (66.8 ± 14.7 vs 67.4 ± 15.4 years, $t=0.25$, $p=0.81$). During the follow-up assessment, cases again completed a clinical questionnaire and underwent the same standardised videotaped tremor examination from which a TTS was assigned by a senior neurologist specialising in movement disorders (EDL) who was blinded to the results of the prior assessments, which on average had been performed 5.7 (range 1.5–9.6) years previously.

ET cases enrolled in a brain donor programme

ET cases were enrolled as future brain donors to the Essential Tremor Centralised Brain Repository at Columbia University. They were ascertained by: (1) advertisements in the International Essential Tremor Foundation website and newsletters, (2) advertisements on the Tremor Action Network website and (3) a study website (<http://www.essentialtremor.us/>). Cases lived throughout the USA and were not restricted to the local New York area.

Each case was mailed a demographic and clinical questionnaire and a study consent form, approved by our institutional ethics committee, which they signed. They also received a typed videotape protocol, which provided detailed instructions to guide a family member or their physician in creating a 20 min visual segment of their tremor. The videotape protocol and method of rating videotapes was identical to that described above for the epidemiological study, with a TTS assigned by a senior neurologist specialising in movement disorders (EDL). Between 2003 and January 2009, 324 cases had enrolled as prospective brain donors. In March 2009, we began selecting cases for follow-up assessment and have re-assessed 39 to date. Selection for follow-up was based on age (< 80 years) and all such selected participants agreed to a follow-up assessment. For the follow-up assessment, the videotape protocol and method of rating videotapes was identical to that described above. Cases signed informed consent approved by the CUMC ethics committee. These 39 cases are similar to the larger group of 324 from which they were drawn in terms of baseline tremor severity (TTS, 23.8 ± 5.7 vs 21.6 ± 7.4 , $t=1.79$, $p=0.07$), tremor duration (41.0 ± 22.2 vs 38.2 ± 21.4 years, $t=0.77$, $p=0.44$) but as would be expected based on the method of selection, they were older (82.1 ± 4.6 vs 73.9 ± 9.9 years, $t=5.10$, $p<0.001$).

Statistical analyses

The annual change in the TTS was calculated as the difference between the baseline and follow-up scores divided by the time (years) elapsed between the two assessments. To calculate the annual percentage increase in TTS from the mean baseline score, we divided the annual change in TTS by the mean baseline TTS and then multiplied by 100. The annual change in TTS was normally distributed, and to test whether the annual increase in TTS differed from the null situation (ie, null=an annual increase of 0.0 points), a one sample Student's t test was performed. To examine the baseline factors that predicted rate of annual change (dependent variable), we performed a series of 13 linear regression analyses. In each analysis, we included as an independent variable one of 13 baseline predictors (eg, age, gender, etc) and we also adjusted for the length of the follow-up period. All analyses were performed in SPSS (V.17.0).

RESULTS

ET cases enrolled in an epidemiological study of ET

These 44 ET cases had a mean baseline age of 66.8 ± 14.7 years and a mean age of tremor onset of 40.1 ± 20.2 years (table 1).

On average, 5.7 years (median 5.6, range 1.5 – 9.6 years) had elapsed between the baseline and follow-up assessments (table 2).

The TTS increased by 0.5 or more points in 33/44 (75.0%) cases and by 5 or more points in 11/44 (25.0%) cases; on average it increased by 2.2 points (median 2.0) (table 2).

The TTS increased annually by 0.32 ± 0.89 points, which represented an annual increase of $5.3 \pm 17.1\%$ from the mean baseline TTS score (table 2). The annual increase of 0.3 points differed from the null situation ($p=0.02$).

In 9/44 (20.5%) cases, the baseline TTS was higher than that at follow-up; however, in all but one of these, the follow-up period was <5 years. Of the 24 cases with ≥ 5 years of follow-up, the TTS increased by 0.5 or more points in 23 (95.8%); the annual increase in the TTS (from the mean baseline score) in these 24 cases was $4.3 \pm 6.0\%$.

To assess the impact of ET medications, we performed two sensitivity analyses and the results were similar. Firstly, we restricted the analysis to five cases whose medications had not changed between assessments. There was a $21.7 \pm 48.9\%$ annual increase in TTS from the mean baseline TTS score; however, one case was an outlier (108.9% increase) and the median annual increase was only 2.6%. Secondly, we restricted analyses to the 18 cases who used no ET medications at baseline or at follow-up; there was a $4.9 \pm 7.4\%$ annual increase in TTS from the mean baseline TTS score.

We examined baseline predictors of annual change in TTS; longer duration tremor was marginally associated with less annual change and jaw tremor was associated with less annual change (table 3).

In a series of 13 regression analyses that separately tested each of 13 potential baseline predictors and adjusted for the length of the follow-up period, tremor duration ($\beta=-0.03$, $p=0.38$) was not associated with rate of annual change in TTS nor was jaw tremor ($\beta=-0.24$, $p=0.20$). None of the remaining 11 baseline predictors was associated with rate of annual change in TTS.

ET cases enrolled in a brain donor programme

These 39 ET cases had a mean baseline age of 82.1 ± 4.6 years and a mean age of tremor onset of 41.0 ± 23.5 years (table 1). On average, 4.3 years (median 4.7, range 0.6–6.3 years) had elapsed between the baseline and follow-up assessments (table 2).

The TTS increased by 0.5 or more points in 26/39 (66.7%) cases and by 5 or more points in 9/39 (23.1%) cases; on average it increased by 1.9 points (median 2.5) (table 2). The TTS increased annually by 0.64 ± 1.49 points, which represented an annual increase of $3.1 \pm 8.1\%$ from the mean baseline TTS score (table 2). The annual increase of 0.64 points differed from the null situation ($p=0.01$).

In 13/39 (33.7%) cases, the baseline TTS was higher than that at follow-up; however, in all but four of these, the follow-up period was <5 years. Of the 15 cases with ≥ 5 years of follow-up, the TTS increased by 0.5 or more points in 11 (73.3%); the annual increase in the TTS (from the mean baseline score) in these 15 was $1.8 \pm 2.9\%$.

To assess the impact of ET medications, we performed two sensitivity analyses and the results were similar. Firstly, we restricted the analyses to 16 cases whose medications had not changed between assessments; there was a $1.6 \pm 6.7\%$ annual increase from the mean baseline score. Secondly, we restricted analyses to the 10 cases who used no ET medications at baseline or at follow-up; there was a $5.9 \pm 12.8\%$ annual increase from the mean baseline score.

We examined baseline predictors of annual change in TTS (table 3); only rest tremor was associated with greater annual change. In a series of 13 regression analyses that separately tested each of the 13 baseline predictors and adjusted for the length of the follow-up period, only rest tremor was marginally associated with greater annual change ($\beta=0.81$, $p=0.06$).

DISCUSSION

We prospectively examined two groups of ET cases, performing our second examination on average 4.3–5.7 years and as long as 9.6 years after the initial examination. Cases were not selected for a second examination based on a need for clinical care. Most patients, and particularly those who were followed for 5 or more years, exhibited a worsening in tremor scores across the two time intervals. Using the mean baseline tremor score as the reference, the average annual increase in tremor severity was 3.1% (median 2.0%) in one study sample and 5.3% (median 1.8%) in the other, values that are lower than have been reported previously.⁶¹⁶

Longitudinal data are available from two prior studies,⁶¹⁶ which together enrolled a sample of 89 cases, approximately the number we enrolled in our combined sample ($n=83$). Being clinic based,⁶¹⁶ the prior studies likely selected patients who elected to return to appointments due to worsening tremor and hence were likely to have overestimated the rate of decline in ET.⁶¹⁶ Indeed, one of the studies noted that they excluded 83 patients who did not return for follow-up and that these 83 had considerably higher tremor scores at the first clinic visit (ie, more severe tremor) than did the 45 patients with follow-up data.⁶ That study estimated a 12% yearly worsening in clinical tremor ratings after baseline⁶ which, as predicted, is a yearly change that is 2.3–3.9-fold higher than that which we report (3.1–5.3%). In the other longitudinal study, 44 ET cases were followed over 4 years using accelerometry.¹⁶ The mean tremor amplitude during mass loading increased from 180 ± 194 to 233 ± 282 cm/s^2 between the baseline and 4 year visit, which represented a 7.4% yearly worsening after baseline,¹⁶ which again was 1.4–2.4-fold higher than that which we report in our study.

We used two groups of ET cases thus allowing us to increase our sample size, expand our analyses to a second sampling frame and obtain a broader spectrum of cases. One group of cases was enrolled as brain donors and their tremor was more severe than that of our other sample. On the one hand, this may have resulted in an overestimate of clinical worsening in the one sample because these were individuals with severe ET. On the other hand, rating tremor in more severe cases could have meant that there were ceiling effects, causing us to underestimate the annual rate of change. Empirically, this group evidenced a rate of change of 3.1%, which was lower than yet well within the range of that observed in our other group of cases, suggesting that these issues are not a major concern.

A limitation of this study is that many of our patients were taking medications for ET and these medications were not held on the day of the evaluation. While this may have influenced the results, in two different sets of sensitivity analyses, we examined our results. Firstly, we restricted ET cases to those whose medications had not been adjusted between assessments or who were taking no medications and, secondly, we restricted ET cases to those who were not on ET medications. The annual rate of change was similar to that which we reported in our main analyses, suggesting that such medication effects were not important. A second limitation is that our study was not population based; indeed, no studies to date have been population based, and such studies are needed to estimate the annual rate of change in community dwelling cases in whom the change might be expected to be low. Thirdly, our clinical rating scale lacked the precision of quantitative computerised tremor analysis, as has been used in one prior study.¹⁶ Finally, a larger number of follow-up assessments would have served to increase the precision of our estimates.

One caveat is that rate of change in tremor severity may not be linear and other non-linear models may better approximate the data on rate of change. Also, the rate of change could vary based on disease characteristics. For example, it could vary by age. Nevertheless, aside from a weak association with rest tremor, our analyses did not support the notion that rate of change covaried with gender, age or other baseline clinical characteristics, as has been reported in a prior study, which noted that the major factors associated with an increase in tremor severity were asymmetrical tremor ratings and unilateral initial tremor onset.⁶

In a substantial minority of patients (20–30%), tremor did not worsen. In most of these, tremor scores at follow-up were paradoxically lower than those at baseline. Yet these cases almost uniformly had shorter follow-up periods. Tremor in ET varies considerably from moment to moment,²⁴ and this intra-subject variability can result in situations in which tremor seems to improve over time. Continuous physiological monitoring of tremor at each epoch, with averaging of data over a longer (eg, 24 h) period at each epoch, could overcome this limitation.

This study had considerable strengths. First and foremost is that cases were not self-selected for their follow-up assessments based on a need for clinical care, thereby eliminating this important source of bias. Secondly, a detailed clinical assessment was performed, with both postural and kinetic tremors assessed, and kinetic tremors assessed during multiple examination manoeuvres. Thirdly, as part of a research protocol rather than a clinical encounter, the examination that was performed at each time interval was identical and the rating scale and the rater were maintained. Finally, we performed analyses on two parallel samples of cases, thereby allowing for an internal comparison group.

In summary, these data indicate that most ET cases who were followed for 5 or more years exhibited a progressive worsening in tremor scores with time such that the average annual increase in tremor severity from baseline was estimated to be between 3.1% and 5.3% and the median annual increase from baseline was between 1.8% and 2.0%. We hope that these

estimates will be of use to clinicians who are asked to provide quantitative prognostic data to their ET patients.

Acknowledgments

The authors thank Howard Andrews, PhD, Department of Biostatistics, Mailman School of Public Health, Columbia University, for guidance on statistical testing.

Funding This research was supported by the National Institutes of Health Grant R01 NS39422.

References

1. Benito-Leon J, Louis ED. Essential tremor: emerging views of a common disorder. *Nat Clin Pract Neurol*. 2006; 2:666–78. [PubMed: 17117170]
2. Louis ED, Ferreira JJ. How common is the most common adult movement disorder? Update on the worldwide prevalence of essential tremor. *Mov Disord*. 2010; 25:534–41. [PubMed: 20175185]
3. Diaz NL, Louis ED. Survey of medication usage patterns among essential tremor patients: movement disorder specialists vs. general neurologists. *Parkinsonism Relat Disord*. 2010; 16:604–7. [PubMed: 20691629]
4. Davis CH Jr, Kunkle EC. Benign essential (heredofamilial) tremor. *AMA Arch Intern Med*. 1951; 87:808–16. [PubMed: 14829086]
5. Benito-Leon J. Essential tremor: from a monosymptomatic disorder to a more complex entity. *Neuroepidemiology*. 2008; 31:191–2. [PubMed: 18784419]
6. Putzke JD, Whaley NR, Baba Y, et al. Essential tremor: predictors of disease progression in a clinical cohort. *J Neurol Neurosurg Psychiatry*. 2006; 77:1235–7. [PubMed: 17043291]
7. Thanvi B, Lo N, Robinson T. Essential tremor—the most common movement disorder in older people. *Age Ageing*. 2006; 35:344–9. [PubMed: 16641144]
8. Topcuoglu V, Bez Y, Sahin Bicer D, et al. Social phobia in essential tremor. *Turk Psikiyatri Derg*. 2006; 17:93–100. [PubMed: 16755409]
9. Shin DH, Han BS, Kim HS, et al. Diffusion tensor imaging in patients with essential tremor. *AJNR Am J Neuroradiol*. 2008; 29:151–3. [PubMed: 17921227]
10. Louis ED, Benito-Leon J, Ottman R, et al. A population-based study of mortality in essential tremor. *Neurology*. 2007; 69:1982–9. [PubMed: 18025392]
11. Boecker H, Weindl A, Brooks DJ, et al. Gabaergic dysfunction in essential tremor: An 11C-flumazenil PET study. *J Nucl Med*. 2010; 51:1030–5. [PubMed: 20554735]
12. Mally J, Baranyi M, Vizi ES. Change in the concentrations of amino acids in CSF and serum of patients with essential tremor. *J Neural Transm*. 1996; 103:555–60. [PubMed: 8811501]
13. Cerasa A, Messina D, Nicoletti G, et al. Cerebellar atrophy in essential tremor using an automated segmentation method. *AJNR Am J Neuroradiol*. 2009; 30:1240–3. [PubMed: 19342539]
14. Louis ED, Faust PL, Vonsattel JP, et al. Older onset essential tremor: more rapid progression and more degenerative pathology. *Mov Disord*. 2009; 24:1606–12. [PubMed: 19526587]
15. Whaley NR, Putzke JD, Baba Y, et al. Essential tremor: phenotypic expression in a clinical cohort. *Parkinsonism Relat Disord*. 2007; 13:333–9. [PubMed: 17291815]
16. Elble RJ. Essential tremor frequency decreases with time. *Neurology*. 2000; 55:1547–51. [PubMed: 11094112]
17. Louis ED, Zheng W, Jurewicz EC, et al. Elevation of blood beta-carboline alkaloids in essential tremor. *Neurology*. 2002; 59:1940–4. [PubMed: 12499487]
18. Louis ED, Jiang W, Pellegrino KM, et al. Elevated blood harmaline (1-methyl-9h-pyrido[3,4-b]indole) concentrations in essential tremor. *Neurotoxicology*. 2008; 29:294–300. [PubMed: 18242711]
19. Louis ED, Ottman R, Ford B, et al. The Washington Heights-Inwood genetic study of essential tremor: methodologic issues in essential-tremor research. *Neuroepidemiology*. 1997; 16:124–33. [PubMed: 9159767]

20. Louis ED, Ford B, Bismuth B. Reliability between two observers using a protocol for diagnosing essential tremor. *Mov Disord.* 1998; 13:287–93. [PubMed: 9539343]
21. Louis ED, Yousefzadeh E, Barnes LF, et al. Validation of a portable instrument for assessing tremor severity in epidemiologic field studies. *Mov Disord.* 2000; 15:95–102. [PubMed: 10634247]
22. Louis ED, Wendt KJ, Albert SM, et al. Validity of a performance-based test of function in essential tremor. *Arch Neurol.* 1999; 56:841–6. [PubMed: 10404986]
23. Louis ED, Ford B, Lee H, et al. Diagnostic criteria for essential tremor: a population perspective. *Arch Neurol.* 1998; 55:823–8. [PubMed: 9626774]
24. Lundervold DA, Poppen R. Biobehavioral rehabilitation for older adults with essential tremor. *Gerontologist.* 1995; 35:556–9. [PubMed: 7557528]

Table 1

Baseline demographic and clinical characteristics of essential tremor cases

	ET cases enrolled in an epidemiological study (n=44)	ET cases enrolled in a brain donor programme (n=39)
Age (years)	66.8±14.7	82.1±4.6
Female gender	28 (63.6)	22 (56.4)
Education (years)	15.1±4.3	15.0±3.9
Family history of ET or tremor	30 (68.2)	29 (74.4)
Tremor duration (years)	26.3±17.8	41.0±22.2
Age of tremor onset (years)	40.1±20.2	41.0±23.5
Voice tremor on examination	13 (29.5)	17 (43.6)
Head (neck) tremor on examination	16 (36.4)	18 (46.2)
Jaw tremor on examination	6 (13.6)	13 (33.3)
Rest tremor on examination	4 (9.1)	18 (46.2)
Tremor Asymmetry Index	3.2±3.2	3.2±2.7
Takes daily ET medication	23 (52.3)	25 (64.1)
Takes ET medication only as needed	2 (4.5)	0 (0.0)
ET surgery	0 (0.0)	0 (0.0)

Values are mean±SD or number (%).

Family history included first- and second-degree relatives.

Tremor Asymmetry Index=[tremor score right arm – tremor score left arm]; range 0–18. ET, essential tremor.

Table 2

Tremor severity and change in tremor severity in essential tremor cases

	ET cases enrolled in an epidemiological study (n=44)	ET cases enrolled in a brain donor programme (n=39)
Baseline TTS	18.6±6.6	23.8±5.7
Follow-up TTS	20.8±5.7	25.5±7.1
Change in TTS	2.2±4.3	1.9±4.1
Time elapsed between baseline and follow-up evaluations (years)	5.7±2.5	4.3±1.4
Annual change in TTS	0.32±0.89	0.64±1.49
Annual % increase in TTS from mean baseline TTS score	5.3±17.1 (median 1.8)	3.1±8.1 (median 2.0)

Values are mean±SD or number (%).

ET, essential tremor; TTS, Total Tremor Score (range 0–36).

Table 3

Baseline predictors of annual change in Total Tremor Score

	ET cases enrolled in an epidemiological study (n=44)	ET cases enrolled in a brain donor programme (n=39)
Age (years)	$r=-0.02$, $p=0.89$	$r=0.13$, $p=0.44$
Gender		
Male	0.24 ± 0.82	0.59 ± 1.31
Female	0.37 ± 0.94	0.67 ± 1.64
	$p=0.64$	$p=0.88$
Education (years)	$r=-0.04$, $p=0.80$	$r=-0.18$, $p=0.27$
Family history of ET or tremor		
Yes	0.59 ± 0.55	0.66 ± 1.37
No	0.20 ± 1.00	0.58 ± 1.86
	$p=0.19$	$p=0.89$
Tremor duration (years)	$r=-0.27$, $p=0.09$	$r=-0.02$, $p=0.89$
Age of tremor onset (years)	$r=0.22$, $p=0.17$	$r=0.05$, $p=0.77$
Voice tremor on examination		
Yes	0.15 ± 0.95	1.03 ± 1.87
No	0.41 ± 0.89	0.49 ± 0.86
	$p=0.40$	$p=0.26$
Head (neck) tremor on examination		
Yes	0.49 ± 0.85	0.41 ± 1.08
No	0.23 ± 0.92	0.83 ± 1.77
	$p=0.36$	$p=0.39$
Jaw tremor on examination		
Yes	-0.37 ± 1.10	0.65 ± 0.73
No	0.43 ± 0.82	0.63 ± 1.76
	$p=0.04$	$p=0.96$
Rest tremor on examination		
Yes	0.06 ± 1.09	1.17 ± 0.18
No	0.35 ± 0.88	0.18 ± 1.12
	$p=0.55$	$p=0.04$
Tremor Asymmetry Index	$r=0.07$, $p=0.66$	$r=0.01$, $p=0.97$
Takes daily ET medication		
Yes	0.14 ± 1.04	0.59 ± 1.42
No	0.53 ± 0.66	0.72 ± 1.65
	$p=0.15$	$p=0.81$
Takes ET medication only as needed		
Yes	0.47 ± 0.57	NA
No	0.32 ± 0.91	
	$p=0.82$	

Pearson's correlation coefficients and Student's t tests.

Family history included first- and second-degree relatives.

Tremor Asymmetry Index=|tremor score right arm – tremor score left arm|; range 0–18.

ET, essential tremor; NA, not applicable.