

# Identification & Characterization of the Type of Tremors in Handwriting: A Review

S. K. Choudhary<sup>1\*</sup>, Dr. S. L. Vaya<sup>2</sup>

<sup>1</sup>: Assistant Professor, Raksha Shakti University, Ahmedabad-380016, Gujarat,

<sup>2</sup>: Director, Institute of Research & Development, Raksha Shakti University, Ahmedabad-380016, Gujarat

**Abstract:** - Tremor is an unintentional, rhythmic muscle movement involving to-and-fro movements (oscillations) of one or more parts of the body. It is defined as unusual departure of line from its intended course resulting in disturbances in performance of fine motor skills. Determining the causes for occurrence of such non-rhythmic handwritten strokes always impose a challenge for document experts. Forensic document examiners when confronted with shaky line writings are likely to be more inclined towards identifying it as a case of forgery, which may not necessarily be true. These irregularities can also be encountered in the handwritings of some genuine writers suffering from old age or having some health issues or due to illiteracy and many more. The main objective of this article is to highlight some handwriting characteristics significant for classification and characterization of the type and causes of tremors appearing in the handwritings of individuals. It will also aid in listing out the condition specific tremor characteristics which can individualize the different forms of tremors from one another.

**Keywords:** Forensic, Handwriting, Tremor, Age, Health, Illiteracy, Strokes

## I. INTRODUCTION

Tremors in handwriting have important implications for the field of forensic document examination<sup>1,2</sup>. A forensic document examiner is always asked to determine the probable reason for tremor seen in handwriting exhibits. This could be critical if there are questions about the authenticity of a document that is claimed to have been written by someone suffering from genuine motor dysfunctions<sup>1</sup>.

“Corrugated lines are evidence of forgery” is a myth which is floating in almost every mind. Such jerky writings are always misunderstood as the result of forgery, which may not necessarily be true<sup>3</sup>. There are some innocents who write with tremor but can be falsely identified as forging. The handwritings of genuine writers suffering from old age<sup>4</sup> or some physiological disorders<sup>5</sup> or illiteracy usually show shaky and non-rhythmic strokes due to weak neuromuscular coordination when compared to a healthy mature writer.

The questions frequently encountered by the document examiner related to tremor are<sup>6</sup>:

1. Whether the tremor observed in handwriting is genuine or fraudulent?
2. Does genuine tremor have a distinguishing pattern of movement that would be differentiated from fraudulent tremor?
3. What could be the probable reason for occurrence of tremor?
4. Is it possible to distinguish between genuine and false tremulous writing?

Tremor is an unintentional, rhythmic muscle movement involving to-and-fro movements (oscillations) of one or more parts of the body (as seen in figure 1).

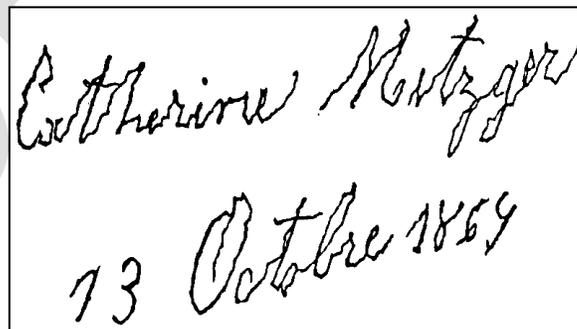


Figure 1: Representation of tremor in handwriting

It is defined as unusual departure of line from its intended course resulting in disturbances in performance of fine motor skills<sup>2</sup>. These tremulous strokes are instant changes from the desired direction of the pen lines and are attributed to nervous impulse affecting the muscles indicating loss of control of the pen.

These non-rhythmic movements are practically impossible to imitate with same writing speed, skill, movement and pen pressure. Wavering and broken strokes forming the letters of a writer’s signature will deviate from the normal style of writing, but they retain sufficient individual and style characteristics to individualize the writer.

There are the many different reasons that tremor occurs in handwriting<sup>7,8</sup>. Tremor can be produced due to age,

due to illness, due to the diseases, brain injury, weak neuromuscular coordination, forgery, illiterate person. Other causes include the use of drug<sup>9,10</sup>, alcohol intoxication, and lack of vitamins, increased stress, writer's cramp and pathological or psychiatric disorders.

## II. CLASSIFICATION OF TREMORS

1. *Tremor of age:* Elderly writings develops tremor due to weak neuromuscular condition. The writing in such cases will be slowly written and showing a tremor which is often rhythmic, wavering and broken strokes forming the letters of a writer writing will deviate from normal writing<sup>11</sup>. Besides all these deteriorations, the internal consistency of the writer remains clearly evident<sup>12</sup>.
2. *Tremor of illiteracy:* The tremor of illiterate and uneducated individuals is more varied because of the unfamiliarity of the writing process<sup>2</sup>. Although there is a lack of the control, the writing is strong<sup>7</sup>. The strong line of the illiterate writer can be distinguished from the lines of the experienced writer in poor health, which are usually lighter more tremulous, weaker and finer.
3. *Tremor of illness:* A person's mental and physical condition affects his/her writing habits. Reason of occurrence of tremor in such cases is due to the weak co-ordination of brain and muscles<sup>13</sup>. Writings in such cases show inconsistency. A writer under severe stress will not be able to write in his/her own manner. Handwriting may sometime deviate to the point of not being recognizable. A long term debilitating illness, such as cancer, will cause handwriting to slowly deteriorate. It is not necessarily a steady decline<sup>14</sup>. There may be some temporary improvement in handwriting, although the writer never regains optimum skill level.
4. *Tremor due to drugs and medication:* Every drug has an effect on the person taking it. Many of the effects are undesirable side effects. Some of these drugs cause changes in person's writing style and even in the ability to write. Nervousness and restlessness causes results in erratic pressure, tremor or other irregularities in writing<sup>9</sup>. Spasms are sudden involuntary muscles contractions that create jerks and glitches in handwriting<sup>16</sup>. Tremor caused by caffeine is vibratory. Light erratic or fading pressures can also be result of muscle relaxants.
5. *Tremor due to alcohol intoxication:* Alcoholism causes uncontrolled muscular movement, jerking and tremor. Breaks in pen lines, irregular strokes and overwritten parts produce an erratic action in handwritings<sup>17, 18</sup>.
6. *Tremor due to the forgery:* Tremor is most easily detected and most frequently found sign of forgery<sup>13</sup>. Tremor results from slow writing or drawing. When a writer slow down to copy or trace a line, the line will become wavier<sup>2, 7</sup>. A fine wave causes corrugation in the

writing line, tiny side to side motion that can be seen under magnification.

## III. GENUINE TREMOR Vs TREMOR DUE TO FORGERY

Despite of the fact that tremors can occur naturally in person's handwriting due to ageing, pathological disorders, illiteracy, physical and mental disorders etc, it is also symptomatic of forgery, where the tremors can be seen due to slowly and carefully drawn writings<sup>19</sup>. A forger, aware of the misdeeds he or she is about to commit develops anxiety and nervousness because of the fear of being caught. Also his/her good soul restrict him or her from conducting any unethical action, due to which tremors in form of hesitation can be clearly evident in forged handwritings<sup>20</sup>, which can easily be differentiated from writings bearing genuine tremors.

Some forgers attempt to imitate writing that contains tremor which is much harder to duplicate. Genuine tremors are more erratic than tremor of forgery. In cases of fake tremor, the forger has a tendency to develop a rhythmic to and fro movement with higher frequency than the genuine case. The forger will usually not place tremor on curves but will execute a smoother stroke than the known writer could have made.

Tremors due to forgery are also seen clubbing up with other inherent signs of forgery like blunt starts and endings, abnormal pen pauses, abnormal pen lifts, retouching, patching etc, which can be significant in discriminating such forms of tremors from genuine tremors<sup>21</sup> (as seen in figure 2).

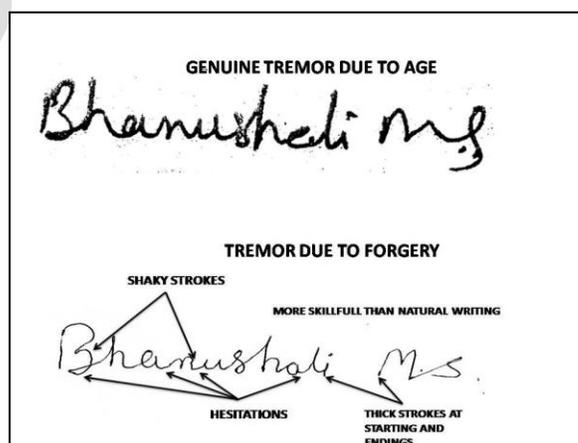


Figure 2: Genuine tremor Versus Tremor due to forgery

## REFERENCES

- [1]. Longstaff M.G. & Heath R.A. (2000); The influence of tremor on handwriting performance under conditions of low and intermediate physical stress; Journal of Forensic Document Examination; vol. 13; pp. 25-44.
- [2]. Katherine M. Koppenhaver (2007); Forensic Document Examination; Humana Press, New Jersey.

- [3]. Albert S. Osborn (1974); Questioned Documents; Nelson-Hall Inc; U.S.
- [4]. T. S. Kapoor et al (1985); Study of the Form and Extent of Natural Variation in Genuine Writings with Age; Journal of forensic science society, Volume 5, Issue 5.
- [5]. Smits E.J. et al (2014); Standardized handwriting to assess bradykinesia, micrographia and tremor in Parkinson's disease; Pubmed.gov.
- [6]. Jacqueline A. Joseph (2016); Genuine Tremor in Handwriting vs. the Tremor of Fraud; Board Certified Forensic Handwriting & Document Examiner; <http://www.ijhandwriting.com/bibliography-genuine-tremor-in-handwriting-vs-the-tremor-of-fraud/>
- [7]. Dewan K.S. Puri (1974); Tremors: Forged or Genuine; International Criminal Police Review. 282:241-244.
- [8]. Brian B. Carney (1995); A New Tremor in Handwriting: Book Review; International Journal of Forensic Document Examiners. 1:75-77.
- [9]. C. Gilmour & J. Bradford (1987); The Effect of Medication on Handwriting; Canadian Society of Forensic Science Journal. 20:119-138.
- [10]. David J. Purtell (1965); Effects of Drugs on Handwriting; Journal of Forensic Sciences. 10:335-346.
- [11]. Ordway Hilton (1977); Influence of Age and Illness on Handwriting Identification Problems; Forensic Science. 9:161-172.
- [12]. Dr. Gayathri Bhagwath (2001); Tremors in Elderly Persons; Hospital Physician; pp. 31 – 37, 49.
- [13]. Ordway Hilton (1969); Consideration of the Writer's Health in Identifying Signatures and Detecting Forgery; Journal of Forensic Sciences; 14:157-166.
- [14]. HongzhiWang et al (2008); Spiral analysis—Improved clinical utility with center detection; Journal of neuroscience methods.
- [15]. M.W. Hirsch (1956); Lysergic Acid Diethylamide (LSD-25): XVII. Effects of LSD-25 and Six Related Drugs Upon Handwriting; Journal of Psychology. 41:11-22.
- [16]. M. Narsimha Pai (1947); The Nature and Treatment of 'Writer's Cramp'; Journal of Mental Sciences. 93:68-81.
- [17]. Albert Rabin & Harry Blair (1953); The Effects of Alcohol on Handwriting; Journal of Clinical Psychology. 9:284-287.
- [18]. K. S. Puri (1965); Effects of Intoxication on Handwriting; Journal of Criminal Law, Criminology and Police Science. 56:372-374.
- [19]. Joe Nickell (1996); Detecting forgery: forensic investigation of documents; The university press of Kentucky, U. S.
- [20]. Michael P. Caligiuri & Linton A. Mohammed (2012); The Neuroscience of Handwriting: Applications for Forensic Document Examination; CRC press, Taylor & Francis Group.
- [21]. George J. Lacy (1944); Handwriting and Forgery under Hypnosis; Journal of Criminal Law and Criminology; Volume 34; Issue 5.

IJSP