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Research Article

Influence of Eye Movements on Writing Pressure During Handwriting: A Cross-Sectional Study

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Abstract
Writing pressure is the pressure applied to the desk when handwriting). Clinical observation of Occupational therapy showed that when many patients with hemiplegia instructed to control writing pressure during writing exercises, they kept their gaze on the pen tip. Based on this phenomenon, we considered that eye movement during writing in patients with hemiplegia might be involved in controlling writing pressure. So, as basic research, we aimed to investigate whether eye movements are involved in the writing pressure during handwriting by healthy participants. The participants were 28 healthy adults (2 men, 26 women, average age 21.8 ± 0.6 years). The task was to draw 10-cm lines from left to right and 20 times from right-to-left. The instruments used were Tracking Glasses (SMI ETG) and an upper limb Coordination Evaluation system Trace coder (SYSNET Co. Ltd.). Based on eye movement data, the participants were classified into "target locking type," including those who kept looking at the goal from the start, and "close pursuit type," including those who kept their eyes on the tip of the pen. In the target locking type, fluctuations in the writing pressure per unit of time value increased greatly when the angular velocity of eye movements changed. In the close pursuit type, fluctuations in the writing pressure per unit of time value were seen at the start of drawing but decreased after that. The results showed that the amount of change in the writing pressure per unit of time value fluctuated greatly in the target locking type and was small in the close pursuit type. These findings suggest that eye movements affect writing pressure during line drawing.

Keywords: Handwriting, Eye Movement, Writing Pressure, Drawing

1. Introduction
Occupational therapists have worked for a long time to improve the activities of daily living for patients with hemiplegia. (Re) acquisition of handwriting ability in target patients is an important item. Many patients with a paralyzed dominant hand have difficulty writing and drawing with their paralyzed hand [1]. Patients with hemiplegia with a mildly paralyzed dominant hand could practice handwriting using the paralyzed hand. However, handwriting skills are greatly affected when the dominant hand is impaired, even with conditions like minor motor paralysis [2]. This is because handwriting requires complex coordination of the muscles of the upper extremities [3]. If writing is not possible with the dominant hand, patients with hemiplegia who have a paralyzed dominant hand have to write and draw with their non-dominant hand [4,5].
In the age of digitalization, handwriting skills are not always necessary. However, it is crucial to retain handwriting ability to prove oneself, such as being asked for a handwritten signature on the back of a credit card [6].

Many patients with hemiplegia complain that their hand prowess is weak when writing. This is due to the fact that the lack of strength in the hands is directly linked to the difficulty in controlling writing pressure.

An easy-to-read character is the one that constitutes a word, has a proper shape and size, and can be clearly distinguished from other characters. Character morphology, writing speed, and fluency can be visually perceived while writing [7]. These are called handwriting skills and have been analyzed in great detail so far [8-10].

Writing (pen) pressure is an important factor in writing easy-to-read characters [8]. Writing pressure is the pressure applied to the desk when handwriting [11]. For patients with hemiplegia, we have been searching for a way to obtain stable writing pressure. Van et al. reported that the changes in writing pressure depended on the writing task and each condition (letters, words, text size, speed, and across a page of text) [12].

In this way, when writing pressure changes due to various factors during handwriting, some type of index is required to generalize changes in writing pressure. Furthermore, considering that Japanese language is composed of straight lines and curves, it is necessary to perform a mechanical task to clarify the relationship between basic writing pressure and eye movement [12]. A previous study reported a method of clarifying handwriting problems in infants was drawing and it also showed that the analysis of changes in writing pressure in drawing can be one of the indicators of handwriting ability [13]. Furthermore, Nishi et al. showed that a simple tracing test displayed on a tablet terminal could be used to evaluate finger dexterity in patients with cervical spondylotic myelopathy and that writing pressure was one of the indicators [14]. Therefore, we analyzed the writing pressure variation by drawing a simple line based on the findings of these studies.

Since a drawing task is simpler than writing letters, writing pressure and eye movement can be measured and analyzed during this task. However, writing pressure cannot be physically visualized. Since 2000, digital drawing has become common, and many detailed studies have been conducted on writing pressure.

Previous studies on writing pressure focused on analyzing changes in writing pressure over time and average writing pressure values [15]. Murase et al. used repetitive transcranial magnetic stimulation in patients with writer's cramp to stimulate the premotor cortex at a subthreshold low frequency (0.2 Hz) that exerts an inhibitory effect on the cortex [16]. The results showed significant improvement in writing pressure fluctuations in patients with writer's cramp. Gatouillat et al. reported that the pen tip normal force (writing pressure) was not affected by the experiment in which they were instructed to draw a circle under varying speed and rhythm conditions [17]. Furthermore, Danna et al. showed that increasing pressure (either passively or actively) on the pen impaired drawing accuracy [11].

Clinical observation showed that many patients with hemiplegia keep their gaze on the pen tip when writing with paralyzed hands. Additionally, when the patients were instructed to control writing pressure during writing exercises, they kept their gaze on the pen tip. By looking at the pen tip, they appear to confirm the movement and power of their hands and the letters. Based on this phenomenon, we considered that eye movement during writing in patients with hemiplegia might be involved in controlling writing pressure. Many studies have been conducted on eye movements, showing that people use visual information through eye movements when they perform tasks with their hands [18].

Eye movements are classified into fixation, smooth pursuit, and saccades [19]. Saccades are rapid eye movements [20], and they guide hand movements [21,22].

Smooth pursuit is an eye movement that slowly follows an object; in recent years, its role is said to be the prediction of motion and collection of visual information (feedback), which are necessary to improve accuracy [7, 23,24].

Visual information plays a crucial role in handwriting and drawing. Chamberlain et al. reported that accurate visual recognition of objects is central to drawing ability [25]. Furthermore, Gowen et al. compared eye movements during tracing and drawing and described visual guidance in eye-hand coordination [26]. Domkin et al. showed that good vision group had fewer errors in tracing and complex tasks than the low vision group [27]. Additionally, Tchalenko reported that "close pursuit" and "target locking" modes and their combination are used for eye movements that occur during simple delineation movements [28]. However, to the best of our knowledge, no reports have investigated changes in eye movement and writing pressure, even if healthy people.

Problems in patients with hemiplegia, even with little or no motor paralysis, have been reported to limit eye-hand coordination [29-32]. Furthermore, obtaining baseline data from patients with hemiplegia is difficult because each individual is affected differently. Thus, we decided to investigate the writing pressure and eye movements during handwriting and drawing with the dominant hand in healthy adults. Results obtained from healthy adults can be used as a reference not only for patients with hemiplegia but also for those with other diseases.

We hypothesized that the writing pressure fluctuation decreases when the line of sight follows the pen tip during drawing (close pursuit type). In contrast, the frequency with which the pen tip is checked decreases, and the writing pressure fluctuation increases when the endpoint of the line is fixed immediately after starting drawing (target locking type).

Students are traditionally taught to draw horizontal lines from left to right when writing Japanese. Thus, drawing horizontal lines from left to right is a familiar task for Japanese people, whereas drawing horizontal lines from right to left is an unfamiliar task even with the dominant hand. If the two have the same result, we predict that this could provide stronger evidence. If visual information is involved in drawing accuracy, teaching patients how to use visual information to control their writing pressure would be a beneficial way to improve their drawing skills.

This study aimed to investigate whether eye movement during a drawing task with the dominant hand in healthy adults affects writing pressure fluctuation.

Methods

Study Design

In this cross-sectional study, healthy participants were asked to draw a line, and their eye movement and writing pressure at that time were uniformly measured. This study was approved by the ethics review committee of Yamagata Prefectural University of Health Sciences (Approval No. 2208-14) and performed in accordance with the Declaration of Helsinki. The participants were informed of the study details and provided written informed consent before the experiment.

Participants

Healthy students enrolled at Yamagata Prefectural University of Health Sciences were recruited as volunteers.

Eligibility criteria were to be at least 20 years old (regardless of gender) and the absence of physical or mental handicap that would make writing difficult. The reason why the participants were set to be over 20 years old was because they had studied Japanese for at least 10 years and were able to write by hand freely.The undergraduate students had different academic backgrounds: 69% was drawn from the Department of occupational therapy, 19% from the Department of physical therapy and 12 from the Department of Nursing.

The exclusion criteria were disabilities that interfered with the measurement of eye movements, such as strabismus, hemianopia, or monocular vision.

The sample size was calculated using G*Power with an effect size of 0.5, α error prob. of 0.05, and power (1 – β error prob.) of 0.8. As a result of considering missing data, such as unmeasurable data, the sample size was 28.

Setting

The experiments were conducted at Yamagata Prefectural University of Health Sciences from April to October 2022.

Experimental equipment

An upper limb coordination evaluation system (TraceCoder, SYSNET Co. Ltd., Osaka, Japan), stylus pen (Microsoft Corporation), personal computer tablet (Surface Pro, Microsoft Corporation, Washington, USA), and webcam (HD Webcam C615n, Logitech) were used to measure writing pressure. The tablet device used for writing pressure measurement has a resolution of 10.6 inches/1920 × 1080 pixels, and the pitch is 0.122 mm. The time resolution of TraceCoder was 25 Hz, and measurement was possible up to 5 N. Its temporal resolution was 30 Hz, and its writing pressure resolution was 0.1 g. A glass-type eye movement measurement device.

SensoMotoric Instruments Eye Tracking Glasses (SMI ETG) with Smart Recorder (SensoMotoric Instruments GmbH, Germany) was used to measure eye movements. This was used with a temporal resolution of 60 Hz and a spatial resolution of 0.5°. Therefore, 1.0° of vision from a distance of 30 cm from the visual object is 0.5 cm and 3.7 pixels on the screen. Moreover, those images were displayed at 1280 × 960 pixels. We photographed the distance between the eyeball and trace coder on the participant's sagittal plane with a web camera (30 Hz). A more secure detection of smooth pursuit and saccade eye movement would require faster eye track and web camera (>1000 Hz) [33].

Precise detection of smooth pursuit and saccade eye movements, although of theoretical importance, is not the subject of the present study and does not affect any of its outcomes or conclusions.

The participant's gaze position was displayed as a gaze point on the BeGaze monitor in accordance with the actual video monitor.

Procedure

The handedness of the participants was determined using the Edinburgh Handedness Inventory. The participants wore SMI ETG glasses and sat in front of a desk with a height of approximately 70 cm. The tablet and stylus pen were placed in front of the participant. Two parallel vertical lines (A (right) and B (left)) were drawn on the tablet with an interval of 10 cm, and the vertical lines were arranged so that the center line was on the participant's midline. The task was to draw a horizontal line with one pen between the two vertical lines (A and B) using the hand determined to be the dominant hand by the Edinburgh Handedness Inventory.

Participants were instructed to draw one set (three) of horizontal lines in the initial drawing pattern of each subject as a pre-practice to familiarize themselves with the experiment. Before the experiment, SMI ETG was thoroughly calibrated. At the beginning of the experiment, the participants were instructed to close their eyes. Then, they were instructed to open their eyes at the start signal and draw a horizontal line from A to B (left to right) or from B to A (right to left).

In the experiment, 1 set of 10 horizontal lines from A to B and 1 set of 10 horizontal lines from B to A were drawn, 2 sets each day (total 4 sets). Within-participant order effects were controlled by counterbalancing each condition to all trial orders. Moreover, the participants did not receive instructions on how to hold the pen, speed of writing, or accuracy to avoid influencing their writing pressure and eye movements.

A total of five measurement items were used, including the writing pressure and eye movement items. The measurement items in the writing pressure measurement were the writing pressure value over time and the task performance time. The measurement items for eye movement were maximum and average angular velocity.

The task performance time was defined as the starting point when the pen touched the tablet and the ending point when the pen left the tablet after drawing the line. The writing pressure value was taken as a measurement value every 40 ms.

From the start to the end of the motion, the sum of the writing pressure values calculated for each analysis time was divided by the motion performance time to obtain an average writing pressure value. The amount of change in the writing pressure per unit of time value was obtained by subtracting the writing pressure value after 40 ms from the previously measured writing pressure value, converting it into an absolute value, and dividing it by the elapsed time (40 ms).

The angular velocity was the moving speed of the gaze point every 16.5 ms. However, blinking and deviating gaze points were regarded as missing data. The maximum angular velocities were extracted from the angular velocities calculated for each analysis time from the start to the end of the participant's line drawing.

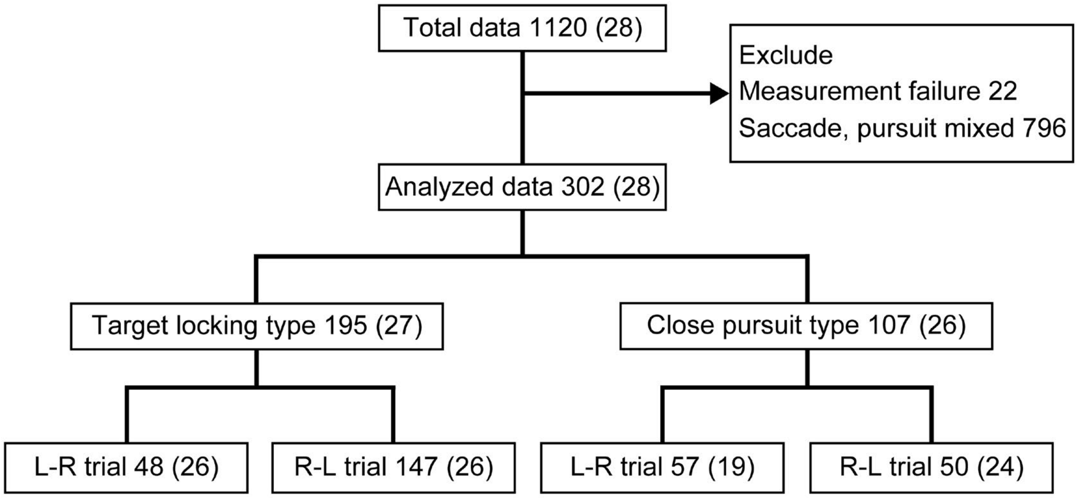

Figure1: Data analysis flowchart.

The number is the amount of data. Numbers in brackets are the actual number of participants.

Data Analyses

Data analyses were performed using behavioral and gaze analysis software for eye tracking data (BeGaze). Eye movements were classified based on Tchalenko's report by looking at the images of gaze movements at the gaze point [28].

We focused on the eye movements on the viewpoint for the obtained data and set the data in which the line drawing was completed by directly looking at the goal point immediately after the start of the line drawing as the target locking type.

Additionally, we extracted angular velocities of 100°/s or more for the target locking type. The close pursuit type was defined as the one in which the stylus pen was followed, and the movement was performed. Angular velocities of less than 100°/s were extracted for the close pursuit type. These speed classifications were based on previous reports that showed that the tracking speed increases when the visual object accelerates [34,35]. Data with mixed target locking and close pursuit types were excluded. For example, data that tracked the pen tip halfway through the movement and locked the target for the rest of the movement. After that, data were classified into the left–right line (L-R) trial and the right–left line (R-L) trial according to the line drawing direction (Figure. 1). After analyzing these measurement items, we compared the average writing pressure value and the amount of change in the writing pressure per unit of time value for the target locking and close pursuit types of the L-R and R-L trials. Additionally, in the L-R and R-L trials, the change in the writing pressure per unit of time values was analyzed using the receiver operating characteristic (ROC) curve between target locking types and close pursuit types to obtain the cutoff value.

Statistical Analyses

Statistical analyses were performed using IBM SPSS Statistics version 24 (IBM Corp., Armonk, NY, USA). Normality was determined using the Kolmogorov–Smirnov test. Data were analyzed using an unpaired t-test when normally distributed and the Mann–Whitney U test when the distribution was not normal. The type of eye movement and the cutoff value were determined using ROC analysis, where target locking and close pursuit types were used as the dependent variables, and the amount of change in the writing pressure per unit of time value was used as the independent variable. The significance level for each test was set at less than 5%.

Results

A total of 28 healthy adults (2 men and 26 women; average age ± standard deviation: 21.8 ± 0.6 years) were included in this study. All the participants were right-handed (Table 1). Of the 1,120 total data of the participants, 1,098 were analyzed. The rest of the data were not analyzed due to eye movement problems such as blinking and deviation of the fixation points. From there, 302 data were used for the analysis, excluding data in which target locking and close pursuit types were mixed (target locking type, 195 data, 27 participants; close pursuit type, 107 data, 26 participants). A comparison between the target locking and close pursuit types was performed using the Mann–Whitney U test.

Table 1: Participants characteristics.

	L-R trial (*n* = 546)	R-L trial (*n* = 552)
Number	28	
Age (year)	21.1 ± 0.5	
Sex (male/female)	2/26	
Dominant hand right/left	28/0	
Task performance time (ms)	1,356 ± 489	1,362 ± 539
Max angular velocity (°/s)	185 ± 85	234 ± 107
Average angular velocity (°/s)	11 ± 6	14 ± 7
Average writing pressure (g)	477 ± 200	664 ± 313

Data are presented as average ± standard deviation.

The amount of change in the writing pressure per unit of time value in a succession of five times for the target locking and close pursuit types of participants are shown in Figure 2. In the target locking type, fluctuations in the writing pressure per unit of time value increased greatly when the angular velocity changed. In the close pursuit type, fluctuations in the writing pressure per unit of time value were seen at the start of drawing but decreased after that. Table 2 shows the target locking and close pursuit types for each line drawing direction.

Table 2: Comparison between the target locking type and close pursuit types.

Item	L-R trial Median (mine and Maximum)				R-L trial Median (mine and Maximum)			
	Target locking type (48)	Close pursuit type (57)	*p*-value	effect size *d*	Target locking type (147)	Close pursuit type (50)	*p*-value	effect size *d*
Task performance time (ms)	816 (576–1,290)	1,986 (774–3,184)	0.001	−0.76	989 (593-2,777)	1,863 (813-3,406)	0.001	−0.87
Maximum angular velocity (°/ms)	262 (105–432)	59 (1–85)	0.001	−0.86	311 (9–553)	58 (2–241)	0.001	−1.00
Average angular velocity (°/ms)	16 (7–28)	6 (2–14)	0.001	−0.78	15 (17–32)	7 (1–18)	0.001	−0.78
Average writing Pressure value (g)	217 (54–422)	197 (103–436)	0.239	−0.12	274 (98–592)	299 (172–420)	0.164	−0.14

Mann–Whitney U test

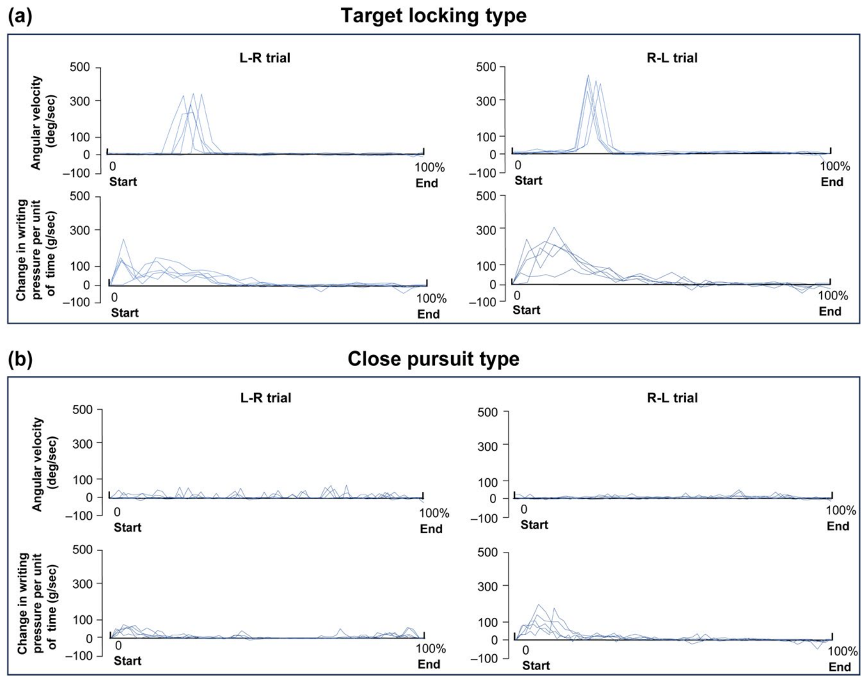

Figure 2: Changes in writing pressure per unit of time value in the two types.

The figure shows changes in angular velocity and writing pressure per unit of time value for typical participants of the target locking and close pursuit type participants. The upper row (a) shows the target locking type, and the lower row (b) shows the close pursuit type participants. Data were extracted 5 consecutive times. The elapsed time of each trial was superimposed as 100%Based on these results, an ROC analysis was performed on the change in the writing pressure per unit of time value for the target locking and close pursuit types. In the ROC analysis, the area under the curve (AUC) of the L-R trial was 0.846, and the cutoff value of the target locking, and close pursuit type was 37 g. Moreover, the AUC of the R-L trial was 0.826, and the cutoff values of the target locking, and close pursuit types were 77 g (Figure. 3).

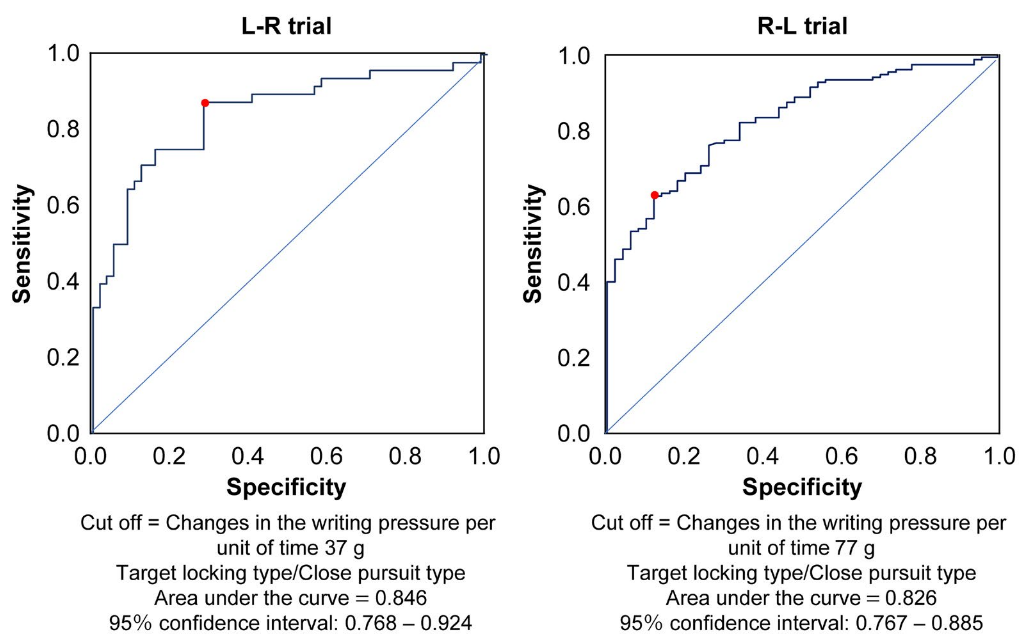

Figure 3: ROC curve between the target locking and close pursuit types.

The left and right sides are for the L-R and R-L trials, respectively. The red dot in the curve is the cutoff point.

Discussion

This study aimed to investigate whether eye movements were involved in writing pressure fluctuations during drawing tasks in healthy adults.

Based on the movement images and angular velocity, we determined that the eye movement of the target locking type was a saccade eye movement. By contrast, as observed in the close pursuit type, follow-up eye movements were the main focus when drawing a line with the viewpoint of the pen tip. Young stated that the angular velocity of smooth pursuit was 20–40°/s [36].

In this study, nearly no data showed significantly lower angular velocities. We found that small saccades were mixed in the data while following the pen tip. Tchalenko also reported small saccades [28]. A small saccade seen in smooth pursuit is called a catch-up saccade, which plays a role in compensating for the loss of sharpness of the visual image [37, 38]. A smooth pursuit can also activate the prediction function and compensate for the lag from the pursuit target [39]. On the contrary, Further, smooth pursuit eye movements play a role in maintaining visual acuity and providing visual feedback [37]. These functions are intended to capture objects without deteriorating visual precision. It can be said that eye movement is necessary for keeping looking at the moving pen tip accurately.

The comparison of task performance time, maximum angular velocity and average angular velocity, average writing pressure, and changes in writing pressure per unit time between the target locking and the close pursuit type revealed that only the average writing pressure did not differ.

Regarding the relationship between writing speed and writing pressure, the writing pressure value has been reported to increase as the writing speed increases [40]. However, Gatouillat et al. showed that pen tip speed did not affect writing pressure in a circle drawing experiment [17].

Horie et al. also reported that the degree of change in pen pressure was greater during fast writing than during the slow writing task. Based on these reports, this study did not instruct participants to intentionally increase writing speed. Thus, no difference in the average writing pressure values was observed [41].

However, the results of comparing the change in the writing pressure per unit of time value between the target locking and close pursuit types were different. For both trials (R-L trial and L-R trial), the change in the writing pressure per unit of time value was high in the target locking type. The higher the value, the greater the fluctuation, and the lower the value, the smaller the fluctuation and the more stable the writing pressure.

Comparing the changes in writing pressure values per unit time during eye movements for each saccade and pursuit, we see large fluctuations in pen pressure during saccades. The visual sensitivity decreases during saccades [42-44]. In other words, it can be inferred that line drawing during saccades is performed based on the proprioceptive information of the hand [45, 46].

We speculate that peripheral vision aids pen tip progression once the gaze has moved to the destination [24, 36, 47].

On the other hand, there have been many reports on the relationship between saccade or smooth pursuits eye movement and upper limb movement [48-51].

Kattoulas et al. stated that signals specifying the metrics of limb movements influence signals specifying the metrics of the saccade that precedes it [52]. Sinha et al. state that smooth pursuit eye movements play a role in the modulation of anticipatory control of hand force to stabilize posture against contact forces [30].

In this experiment with healthy adults for the familiar direction (L-R), the change in the writing pressure per unit of time value increased during saccades and decreased during smooth pursuit. Similar results were obtained for the unfamiliar direction (R-L). These findings suggest that differences in eye movement (presence or absence of visual information) affect writing pressure control.

The cutoff value of the change in the writing pressure per unit of time value in the L-R direction was 37 g. We could distinguish between the saccade and pursuit types with a smaller cutoff value. On the contrary, the cutoff value of writing pressure change per unit of time value in the R-L direction was 77 g, which is about twice that in the L-R direction. We speculated that this was because the participants were not accustomed to drawing lines and could not use visual information to stabilize their writing pressure effectively. Studies have reported that the involvement of visual information activates other somatosensory sensations, and we are convinced that writing pressure is one such example [53-54]. Although it is a tracking task, studies have reported that hand movements facilitate eye movements [55].

Gopal et al. reported kinematic plans for eye and hand movements demonstrated with optimal precision and speed since hand speed modulates saccade movements [56]. Alternatively, task execution time was determined when the target locking type fixed the endpoint. However, this shows that there is no resistance on the supporting surface. There is resistance from the tablet, and this is related to writing pressure. We speculate that pressure fluctuations occur in an attempt to neutralize the resistance that occurs in their hands. We guess that these differences in fluctuations were reflected in the value of writing pressure change per unit of time value.

The study results were obtained using the dominant hand of a healthy person. Thus, these results may differ from those of patients with hemiplegia, which can be a future research topic.
Based on the findings that visual information is involved in adjusting the writing pressure, we concluded that we could provide more specific support in controlling writing pressure for drawing

and writing by patients with hemiplegia. In other words, visual information provided by eye movements and other pieces of sensory information (proprioceptive information for line drawing) work together to make smoother movements. Thus, we believe that looking closely at the pen tip is useful not only for confirming the shape and speed of characters but also for adjusting the writing pressure.

Rizzo et al. showed that the loss of saccade control may affect visually induced hand movement control in eye movements in patients with hemiplegia [29]. Additionally, Singh et al. reported that patients with hemiplegia performed more saccades during sustained reaching movements [30]. The study also reported the number of saccades made by stroke survivors during ongoing reaching movements, which were strongly associated with slower reaching speed, decreased reaching smoothness, and greater difficulty performing functional tasks.

Based on the findings of these studies, the drawing of patients with hemiplegia could be affected by eye movement disorders even with mild motor paralysis. Disturbances in eye-hand coordination occur irrespective of most brain lesions and have no structure-specific component [32]. Based on these reports, we speculated that the visual problems of patients with hemiplegia vary from person to person. As mentioned above, training for patients with hemiplegia should include adequate visuomotor assessment, such as the Trail Making Test [57]. Based on the assessment results, improvement of eye movement (like visual search,) and writing pressure control practice should be performed in parallel, requiring integrated grading. For patients with hemiplegia, the first step is to determine the target point and draw a line toward the target point. In addition, the performance of handwriting skills in the real world requires a complex set of abilities, including force regulation to maintain constant writing pressure, muscular endurance to write for extended periods of time, and cognitive and perceptual skills [58-60]. These are challenges that must be overcome during the rehabilitation process, including occupational therapy [61- 64].

This study has some limitations. The temporal resolution of the writing pressure-measuring device was rough, and it was not possible to obtain measurement values synchronized with eye movements. With tighter synchronization, clearer results can be expected. Eye movement measurement judges “seeing” or “not seeing” from the direction in which the corneal reflex is generated, and it cannot be asserted whether visual information is reliably captured. Thus, determining the presence or absence of visual information input by combining corneal pupillary response and other factors is necessary.

So far, dysgraphia has been reported not only in patients with hemiplegia, but also in patients with Parkinson's disease, developmental disorders, and writers' cramps. To respond to such diverse diseases, it is necessary to continue research including many participants. [63, 65-67].

Conclusion

In the 10 cm line drawing task, the change in the writing pressure per unit of time value was large during saccade eye movements in both L-R and R-L directions and was small during pursuit. The reduction in visual information during saccades was considered to increase the variation in the amount of change in the writing pressure per unit of time value. These results suggest that eye movements are involved in writing pressure control.

Authors Contributions

Y.S and H.F conceptualized and designed the study. Y.S analyzed data , interpreted the results and wrote the first of the manuscript. H.F revised the article critically for important contents. Y.S and H.F approved the final version and agree to be accountable for all aspects related to the accuracy or integrity of the work.

Statements and Declarations

Data Availability

Raw data were generated at Yamagata Prefectural University of Health Sciences. Derived data supporting the findings of this study are available from the corresponding author (Yumi Suzuki) on reasonable request.

Competing Interests

The authors have no competing interests to declare that are relevant to the content of this article.

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