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The Effects of *Camellia sinensis* O. Ktze. Extract on Dynamic Vision—A Randomized, Double-Blind, Placebo-Controlled, Parallel-Group Study

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Abstract

Background: The degradation of dynamic vision due to aging and visual display terminal (VDT) work is considered to significantly affect the quality of daily life. The intake of green tea containing epigallocatechin gallate (EGCG) has been reported to improve dynamic vision and is expected to prevent its decline. However, no clinical study has ever been conducted to evaluate green tea's effect on dynamic vision in humans. Therefore, we aimed to evaluate the effects of a supplement containing green tea (*Camellia sinensis* O. Ktze.) extract rich in EGCG on dynamic vision in humans. **Methods:** A randomized, double-blind, placebo-controlled, parallel-group study was conducted to evaluate the effects of *Camellia sinensis* O. Ktze. extract on dynamic vision in healthy participants. Forty healthy men and women were enrolled and randomly divided into an active group that consumed a supplement containing *Camellia sinensis* O. Ktze. extract (100 mg epigallocatechin gallate/day) for 6 weeks and a placebo group that consumed a supplement without the extract for the same period. The primary outcome was kinetic visual acuity (KVA). The secondary outcomes were the results of a questionnaire survey and a cognitive function test. **Results:** The active group showed a statistically significant improvement in KVA, compared to the placebo group ($P < 0.05$). In addition, no adverse events attributable to the studied supplements were observed during the study period. **Conclusions:** These findings indicate that consuming supplements containing *Camellia sinensis* O. Ktze. extract may positively impact dynamic vision.

Keywords

Camellia Sinensis Extract, Epigallocatechin Gallate, Visual Function, Dynamic Vision

1. Introduction

A wide variety of bodily functions decline with age, one of which is visual acuity. Visual acuity is classified into two categories: static vision, which is the ability of the eye to distinguish between two points, and dynamic vision, which is the ability to distinguish moving objects [1]. Both static and dynamic vision decline with age, but the decline in dynamic vision is more pronounced than that in static visual acuity and is known to begin in people in their 40s, with a rapid decline after their 50s [2]. In recent years, opportunities to work with visual display terminals (VDTs)—such as computers, smartphones, and video game consoles—have increased, and VDTs have become an indispensable part of modern life. The spread of VDTs has made our lives more convenient and efficient, but it has also affected the decline in various visual functions. In particular, VDT operation has been shown to induce changes in oculomotor function through extraocular muscle strain [3]. Additionally, previous studies have shown that playing video games involving horizontal eye movement temporarily reduces dynamic vision [4].

Dynamic vision has a significant impact on daily life. For example, poor vision interferes with equilibrium and postural control, putting people at risk of falling, and it has been confirmed that the risk of falling increases as dynamic vision declines [5]. Dynamic vision has also been reported to be associated with traffic accidents [1]. Thus, because a decline in dynamic vision is a factor that significantly affects daily life and its quality, preventing an age-related decline in dynamic vision is considered important for maintaining good health.

The tea plant (*Camellia sinensis* O. Ktze.) belongs to the Theaceae family. It has a rich culinary history and has been consumed mainly in China for over 3000 years [6]. In a study using mice, it was confirmed that the administration of matcha or sencha green tea improved their visual motion processing for optokinetic responses, among other dynamic vision abilities, as well as the speed at which their eyes followed moving objects and the speed of the most easily discriminated moving object [7]. Green teas, such as matcha and sencha, contain epigallocatechin gallate (EGCG)—a type of polyphenol known to be an antioxidant—as a characteristic ingredient [8] [9]. As the antioxidant effect of EGCG has been reported to be useful in protecting retinal tissues [10]-[12], it is believed that EGCG is responsible for the effect of tea administration on dynamic vision [7]. However, no human studies have reported the effects of green tea extracts on dynamic vision, and clinical trials are required to evaluate the effects of these extracts.

Therefore, we conducted a randomized, double-blind, placebo-controlled, par-

allel-group study in middle-aged men and women to evaluate the effects of green tea extract intake on dynamic vision, which is impaired by daily life and VDT work. In addition, because dynamic vision is related to the risk of falls [5] [13], a subjective evaluation questionnaire on stumbling was administered. Due to the known association between visual and cognitive function [14] [15], a cognitive function test on study supplement intake was also conducted.

2. Materials and Methods

2.1. Study Design

A randomized, double-blind, placebo-controlled, parallel-group study (allocation ratio of 1:1) was conducted over 7 weeks, consisting of a pre-observation period (1 week) and an intake period (6 weeks). No changes were made to the protocol at the start of the study. Table 1 shows an overview of the study schedule and procedure.

Table 1. Study schedule and procedure.

Item	Enrollment	Test Period		
		Before intake	Start of intake	End of intake
Informed consent	●			
Background investigation	●			
Selection		●		
Allocation		●		
Kinetic visual acuity (KVA)		●●		●●
A subjective evaluation questionnaire				●
A cognitive function test		●●		●●
Intake of study supplement (active or placebo)			⟷	⟷
Food diary			⟷	⟷
Participant diary		⟷	⟷	⟷

● Implementation, ●● Implementation twice (pre- and post-VDT operation), ⟷ Daily practice.

2.2. Study Participants and Setting

The participants were recruited as paid volunteers, and the investigator enrolled Japanese men and women who met the following inclusion criteria and did not violate the exclusion criteria. The subjects were given a full explanation of the details of the study prior to its start, and their written consent was obtained.

Inclusion criteria: 1) males and females aged 40 to 79 years old; 2) subjects who do not have any diseases related to visual and/or cognitive function evaluation; 3) subjects whose binocular static vision is 0.7 or higher (including corrected); 4)

subjects who can make a self-judgment and voluntarily give their written informed consent.

Exclusion criteria: 1) subjects who use supplements, functional foods, or drugs associated with eye fatigue recovery or lack of sleep or antioxidants; 2) subjects with ophthalmologic diseases such as glaucoma or other visual field constrictions; 3) subjects who have a history of and/or contract serious diseases (e.g., diabetes, liver disease, kidney disease, heart disease, cerebrovascular disease); 4) subjects who have a history and/or a surgical history of digestive disease affecting digestion and absorption; 5) subjects who are under treatment for or have a history of alcoholism; 6) subjects taking medications or using eye drops related to eye strain and/or taking medications that affect the eyes; 7) subjects who have declared an allergic reaction to the ingredients of the test supplements; 8) subjects who cannot stop drinking from one day before each measurement; 9) subjects who have an alcohol intake of more than approximately 20 g/day of pure alcohol equivalent and a habit of drinking not fewer than 4 days a week; 10) subjects with extremely irregular eating habits and life rhythms; 11) subjects who are shift workers and/or midnight-shift workers; 12) subjects who have donated over 200 mL of blood and/or blood components within the last one month prior to the current study or over 400 mL of blood and/or blood components within the last three months prior to the current study; 13) subjects who are pregnant or planning to become pregnant or breastfeed during the study period; 14) subjects who are participating in or willing to participate in other clinical studies; 15) subjects who are judged as unsuitable for the current study by the investigator for other reasons.

This study was reviewed and approved by the "Ethical Committee of Kobuna Orthopedics Clinic" (Chairman: Toshio Kawada, approval date: 10 August 2023), in accordance with the "Declaration of Helsinki October 2013 WMA Fortaleza General Assembly (Brazil) Amendments" and "Ethical Guidelines for Medical and Biological Research Involving Human Subjects" (enacted on 23 March 2021, partially amended on 27 March 2023), and was conducted under the supervision of physicians. This study was conducted at the Nihonbashi Cardiology Clinic. The research plan for this study has been registered in the clinical trial registration system operated by the University Hospital Medical Information Network Research Center, with the registration ID UMIN000051892 (name of the trial registration: A Study on the Effect of Food Containing Plant Extract on Visual Function -A Randomized, Double-blind, Placebo-controlled, Parallel-group Study-).

2.3. Intervention

The intervention consisted of the intake of the study supplements and operation of VDTs. The test subjects each took 1 packet (2 tablets) of the test supplement once daily with water or lukewarm water during the test period. Tablets containing green tea (*C. sinensis* O. Ktze.) extract, maltitol, cellulose, calcium stearate, and silicon dioxide were used as the active supplement. For the placebo supplement, the green tea extract in the active supplement was replaced with caramel

coloring, and the amount of maltitol was adjusted such that the placebo supplement was indistinguishable from the active supplement in appearance. The daily intake of both the active and placebo supplements was 250 mg × 2 tablets. Table 2 shows the results of a nutrient composition analysis. The amount of EGCG contained in the active supplement was 100 mg, as per the recommended daily intake (one packet).

The VDT operation consisted of playing a video game using a tablet device for 30 min in the pre-intake test and in the 6-weeks post-intake test, and tablets with the same specifications and settings were used for all subjects. Specifically, on the tablet device screen, 29 identical kanji characters and 1 similar but different kanji character were displayed (5 vertical by 6 horizontal; 30 characters in total). The participants repeatedly tapped on the different kanji characters as soon as they found them. The distance between their eyes and tablet device was kept constant while the VDT operation was performed.

Table 2. Analysis of nutrient composition values of study supplement.

	Placebo supplement (2 tablets)	Active supplement (2 tablets)
Energy (kcal)[a]	2	2
Protein (g)[b]	0.0	0.0
Fat (g)	0.0	0.0
Ash (g)	0.5	0.5
Sodium (g)	0.001	0.000
EGCG(g)	0.000	0.100

a. Calorie conversion factors: protein, 4; fat, 9; and carbohydrate, 4. b. Nitrogen protein conversion factor: 6.25.

2.4. Test Items

The primary endpoint was kinetic visual acuity (KVA), and the secondary endpoints were a subjective evaluation questionnaire and a cognitive function test. The outcomes did not change after the start of the study. Dynamic vision was evaluated using an AS-4F*α* dynamic vision meter (Kowa Co. Ltd.). The participants were asked to respond when they could identify the direction of the break in the Landolt ring approaching from the front in a straight line at a speed of 30 km/h. The decimal visual acuity values of three correct responses were recorded, and the average value, converted to log MAR acuity, was used as the KVA value. Measurements were conducted before and 6 weeks after intake, before and after VDT operation.

The subjective evaluation questionnaire used a Likert scale to evaluate "Stumbling: Compared to before intake, do you feel that you stumble less often on small bumps"? The questionnaire was administered on a 5-point scale (very much less, slightly less, neither agree nor disagree, not much less, or not at all less), and the

results were evaluated after 6 weeks of intake, before VDT operation.

Cognitive function was assessed using the Stroop test. The test consists of four subscales (Steps 1, 2, 3, and 4), and the difficulty level increases as the test requires more complex information processing skills. The number of letters or colors answered (number achieved), number of letters or colors answered correctly (number correct), and number of letters or colors answered incorrectly (number incorrect) at each step were assessed before and 6 weeks after intake, before and after VDT operation. These assessments were performed following the dynamic vision test.

All the test participants were given a food diary and a participant diary. The following survey items were entered daily during the intake period, starting on the day of intake for the food diary and 1 week before intake for the study subject diary: 1) study supplement intake status, 2) pharmaceutical use (pharmaceuticals excluding nutritional drinks, newly designated quasi-drugs, and new ranges of quasi-drugs), 3) changes in physical condition, 4) presence/absence of exercise not normally performed and its contents, 5) changes in living conditions, 6) VDT use contents and their duration, and 7) meal contents (including supplements, functional foods, nutritional drinks, and alcohol)

2.5. Number of Cases

The target number of cases in this study was calculated based on reports of improvements in dynamic vision caused by foods with similar functions (values after the intake period [placebo group: 77.30 ± 8.55, active group: 83.72 ± 6.51]) [16], and the sample size was calculated at a significance level of 0.05 and power of 0.80, giving 19 participants per group. The sample size was set to 20 participants per group (40 participants in total), considering dropouts and discontinuations.

2.6. Research Methods

This study recruited paid volunteers, and the principal investigator included the study participants according to the selection and exclusion criteria. The statistical analyst followed the previously reported method [17] and used JMP (SAS Institute Japan) to set up a custom design with categorical factors for two groups and covariate factors, including gender, age, and dynamic vision test results. Blocks of similar study participants were created (block size of 4). Within each block, participants were randomly assigned to the two groups using computer-generated random numbers, employing a block randomization method. The two groups were assigned to an active group and a placebo group by the study supplement allocation manager, who was not directly involved in the study. In addition, the study supplement allocation manager prepared a table (key code) containing the allocation results and kept it in a sealed container; the key code was disclosed after the analysis participants were determined, thereby ensuring blinding to persons other than the study supplement allocation manager. In addition, the study supplements were placed in plain aluminum bags containing two tablets each and

distributed to the research participants to ensure blinding of the research participants and intervention providers.

In addition, precautions were explained to the research participants to be followed throughout the study period, including that they should lead the same lifestyle as before the study, including the frequency and duration of VDT use; that they should not use drugs that may affect eye fatigue or sleep; and that they should not consume large amounts of alcohol. In addition, the following precautions were taken throughout the study period: no smoking on the day of the examination from the time of waking up; avoiding eye strain, such as prolonged use of smartphones and games, from the day before until the start of the examination; no alcohol consumption on the day before the examination; going to bed early and avoiding staying up late on the day before the examination; and fasting for at least 8 hours prior to the examination. The research participants were required to use medicines only with the permission of the principal investigator or research-associate physician, except in emergency cases.

2.7. Statistical Analysis

The analysis population was defined as the per-protocol set (PPS). The primary endpoints were the change in KVA before VDT operation before and after intake of the study supplement and the change in KVA after VDT operation before and after intake of the study supplement. The secondary endpoints were compared between the groups using the Mann–Whitney U test. Both tests were two-tailed, with a significance level of 5%. Statistical analyses were performed using IBM SPSS Statistics 28. The study participants' backgrounds are presented as means ± standard deviations, and other data are presented as means ± standard errors. No additional analysis was performed.

3. Results

3.1. Analysis Participants

In total, 40 participants (18 males and 22 females) were included in this study. The study was initiated with these 40 participants, with no dropouts after randomization, and the assigned intervention was implemented for 20 participants in each group. During the study period, one (male) patient in the placebo group discontinued the study at the discretion of the principal investigator for reasons unrelated to the study supplement, bringing the total number of completed study participants to 39. After the completion of the study, five participants met the rejection criteria; thus, 34 participants (14 males and 20 females) were included in the analysis. The reason for rejection was that the participants were found to have violated precautions during the study period (three participants in the placebo group and two participants in the active group). The analysis was performed according to the original allocation for each group.

The period from recruitment to the end of follow-up for the study participants was August 2023 to February 2024, and the study was terminated when all participants were followed up. The background of the study participants for the analysis

is shown in Table 3, and a flowchart showing the process from inclusion to analysis is shown in Figure 1.

Table 3. Subject characteristics.

Parameter	Placebo group	Active group
	(n = 16)	(n = 18)
Male/Female	6/10	8/10
Age (years old)	58.9 ± 11.6	58.1 ± 12.5
Height (cm)	161.9 ± 7.9	161.7 ± 8.6
Body weight (kg)	60.9 ± 11.3	60.1 ± 10.8
Static visual acuity	1.0 ± 0.1	1.0 ± 0.0
Kinetic visual acuity	0.34 ± 0.17	0.37 ± 0.18

Values are expressed as means ± SDs. No significant difference was observed.

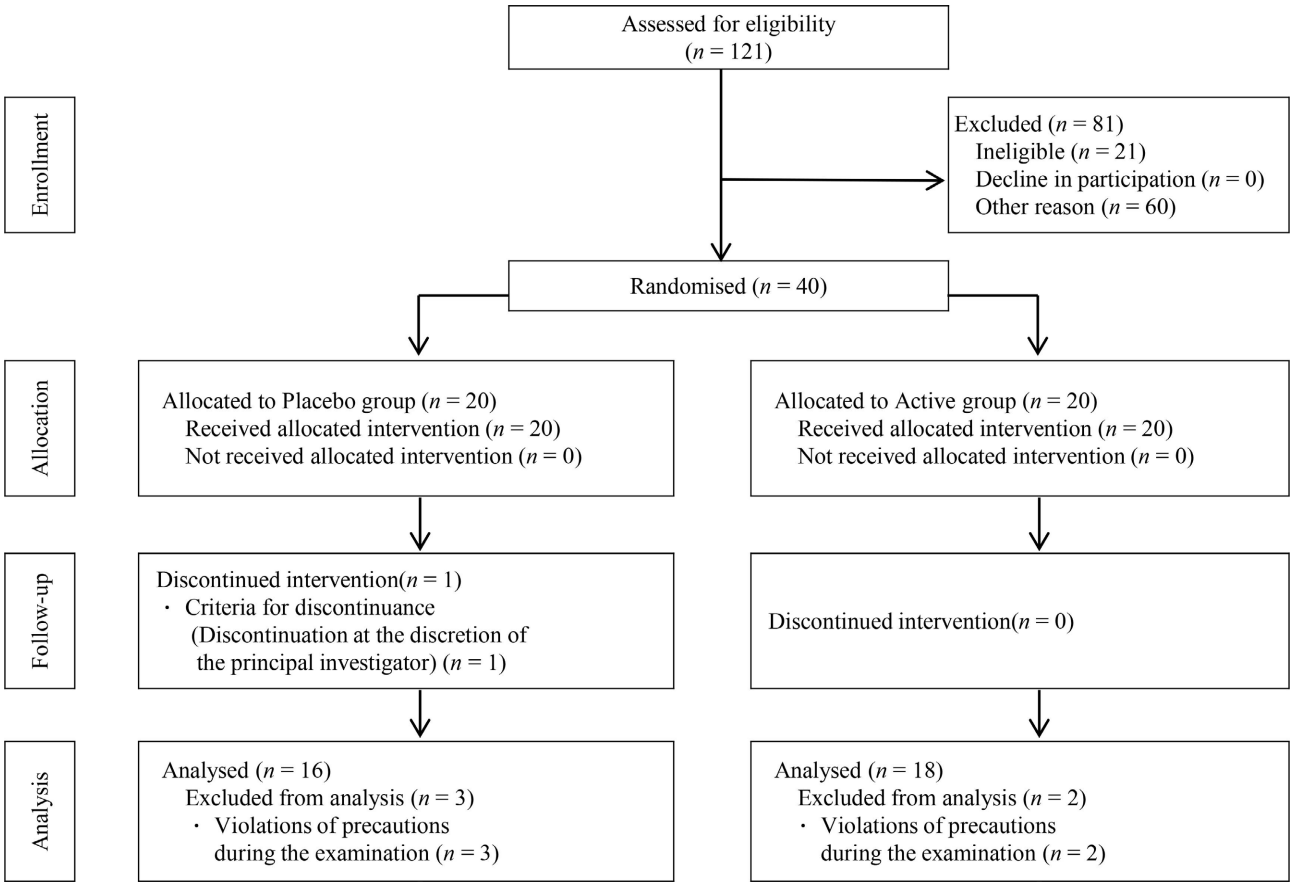

Figure 1. Flow diagram of the study design.

3.2. Analysis Results

Figure 2 shows the pre- and post-intake changes in KVA values before VDT operation, and Figure 3 shows the pre- and post-intake changes in KVA values after VDT operation. A comparison between the two groups showed that the values for

the active group, both before and after VDT operation, were significantly lower than those for the placebo group after 6 weeks of intake [0.08 ± 0.03 in the placebo group and −0.04 ± 0.04 in the active group before VDT operation (P = 0.026); 0.08 ± 0.03 in the placebo group and −0.01 ± 0.03 in the active group after VDT operation (P = 0.041)]. The secondary endpoints, subjective evaluation questionnaires, and cognitive function tests showed no significant differences between the groups before and after the intake of the study supplement (data not shown).

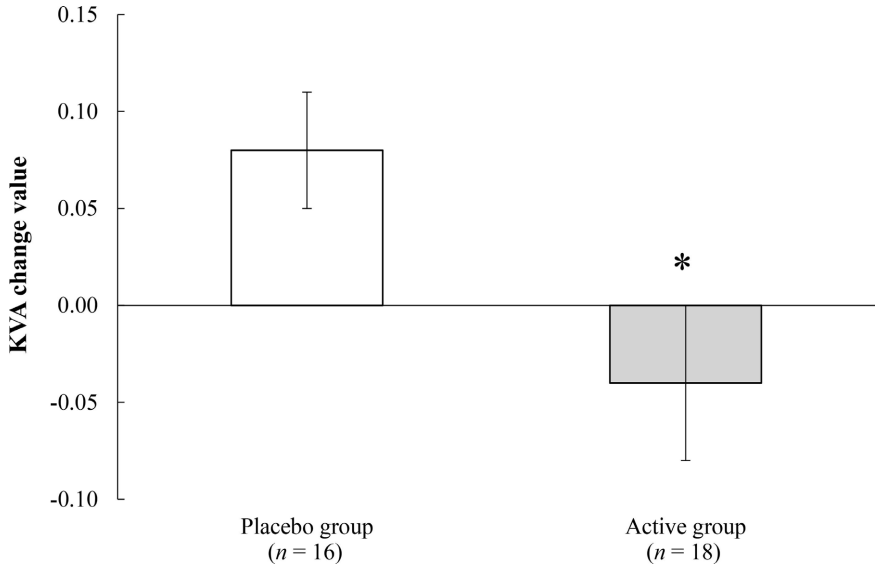

Figure 2. Changes in KVA before VDT operation. Amount of change in KVA before and after intake period of study supplement, before VDT operation. Values are expressed as means ± SEs. *Significantly different from placebo group (P < 0.05).

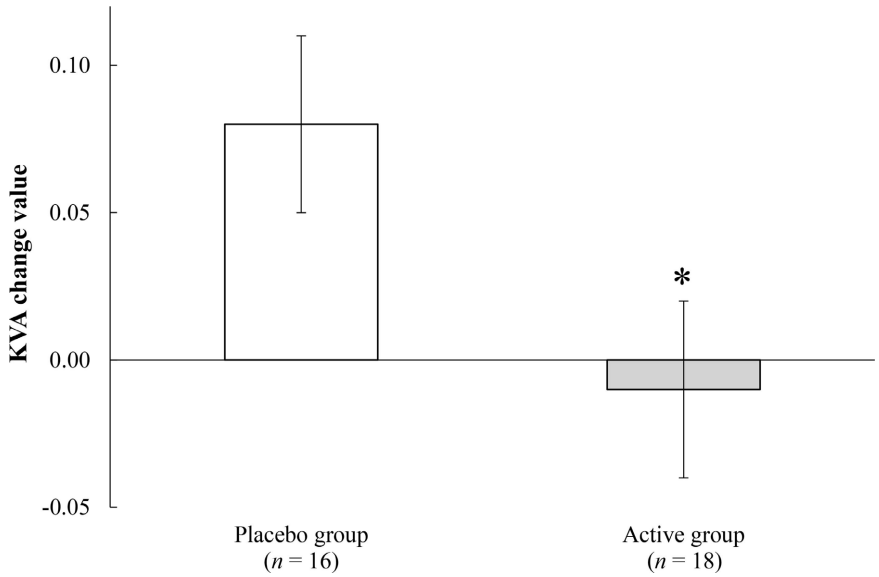

Figure 3. Changes in KVA after VDT operation. Amount of change in KVA before and after intake period of study supplement, after VDT operation. Values are expressed as means ± SEs. *Significantly different from placebo group (P < 0.05).

3.3. Adverse Events

The adverse events experienced during the study period included cold and sore throats in the placebo group and cold and back pain in the active group, with a similar frequency of occurrence. The investigators deny any causal relationship between these events and the study supplement.

4. Discussion

In this randomized, double-blind, placebo-controlled, parallel-group study, middle-aged men and women were asked to consume either a supplement containing green tea extract (active) or a supplement without green tea extract (placebo) once daily for six consecutive weeks to examine the effect of green tea extract-containing supplements on dynamic vision. The results showed that there was a significant difference in the change in KVA values for dynamic vision before VDT operation from before to after six weeks of intake, and the active group showed lower values than the placebo group. As dynamic vision is known to decrease with age, continuous intake of green tea extract may inhibit this decrease in dynamic vision in daily life. Similarly, a significant difference was observed in the amount of change in KVA values after a VDT operation from before to 6 weeks after intake, and the values were lower in the active group than in the placebo group, suggesting that continuous intake of green tea extract may also contribute to suppressing the decline in dynamic vision caused by VDT use. Therefore, based on the results of this study, the intake of a supplement containing green tea extract inhibits the decline in dynamic vision caused by aging and VDT operation.

KVA is an index of dynamic vision—the ability to recognize objects moving back and forth relative to the observer. In addition to KVA, dynamic visual acuity (DVA), which measures dynamic vision in the horizontal and vertical directions, is also known as an index of dynamic vision, but in Japan, KVA is widely used. KVA values indicate that dynamic vision declines with age [2]. It has also been confirmed from KVA values that dynamic vision declines with VDT operation [18]. In light of the above, we believe that the results of this study showing an effect on KVA values indicate an improvement in dynamic vision, especially in the ability to perceive objects moving in the forward-backward direction. Although there are various views on the relationship between KVA and DVA, some studies have suggested a correlation between these two indices in humans [19], and animal studies have shown that the ingestion of green tea extract improves DVA [7], suggesting that green tea extract may be effective not only for vision in the forward-backward direction but also for the overall ability to see objects moving horizontally and vertically.

Oxidative stress in the retina is considered a possible mechanism for a decline in dynamic vision. It has been reported that the retina is prone to oxidative stress accumulation due to light stimulation, which results in photoreceptor cell damage and affects the physiological health of the retina [20]. In addition, oxidative dam-

age to the retina has been observed to reduce visual acuity by decreasing the thickness of the retina [21]. Based on the above, it is thought that the decrease in antioxidant capacity with aging and the increase in light stimulation due to VDT increase the production of reactive oxygen species in the retina, resulting in a decrease in the efficiency of visual information processing and a decrease in dynamic vision.

In contrast, it has been reported that the EGCG contained in green tea extracts has strong antioxidant capacity. Therefore, it is suggested that EGCG intake protects retinal cells, maintaining and improving visual function. In fact, a study in which EGCG was administered to mice confirmed that EGCG reduced oxidative stress in the retina and protected photoreceptor cell function, thereby improving dynamic speed discrimination, which is a type of dynamic vision [7].

Based on the above, the maintenance of dynamic vision confirmed in this study is considered to result from a reduction in oxidative stress in the retina due to the antioxidant effect of green tea extract, especially EGCG.

On the other hand, in the subjective evaluation questionnaire, for "Stumbling: Compared to before intake, do you feel that you stumble less often on small bumps?", there was no significant difference between the active and placebo groups, suggesting that the intake of a supplement containing green tea extract may suppress a decline in dynamic vision but may not be felt to affect stumbling. No significant differences were found between the active and placebo groups on the Stroop test for cognitive function. Previous reports have shown that continuous intake of green tea and powdered green tea for 12 weeks improves cognitive function [22] [23]. Therefore, it is possible that the results in this study showed no difference because of the short duration of green tea extract intake. As the antioxidant effect of EGCG contained in green tea extract may have directly contributed to the protection of photoreceptor cells, the results of the subjective evaluation questionnaire and cognitive function test do not negate the suppression of dynamic vision decline observed as a result of the intake of a supplement containing green tea extract.

In this study, the safety of green tea extract was confirmed. No adverse events attributable to the intake of supplements containing tea extract were observed, suggesting that long-term intake of food products containing green tea extract is safe.

However, this study has several limitations. This study was conducted on middle-aged men and women aged 40 to 79 years, and the effects of the active supplement on younger participants are unknown. Future research should examine the effects of green tea extract on dynamic vision by testing a wider range of subject populations to confirm the effects.

5. Conclusion

In this study, a supplement containing green tea extract was shown to improve dynamic vision in middle-aged men and women.

Authors' Contributions

Conceptualization, T.K. and K.T.; methodology, S.M. and K.F.; validation, S.Y.; formal analysis, K.F.; investigation, S.Y. and M.Y.; writing-original draft preparation, S.Y., M.Y., and K.F.; writing-review and editing, T.O.; visualization, S.Y. and K.F.; supervision, K.T. and Y.I.; project administration, T.O. and T.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethical Committee of Kobuna Orthopedics Clinic (approval date: 10 August 2023; approval number: MK-2308-01).

Informed Consent Statement

Informed consent was obtained from all participants involved in the study.

Data Availability Statement

The data used in this manuscript are not publicly available because of commercial restrictions but are available on reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Japan Safe Driving Center (2000) Untensha no Shintaiteki Kino no Keinen Henka ni Kansuru Chosa Kenkyu Hokokusho. (In Japanese) https://www.jsdc.or.jp/Portals/0/pdf/library/research/h10_3.pdf

[2] Suzumura, A. (1974) Variation of Visual Perception of Spatial Objects and Development of Perceptual Aptitude. *Journal of Japanese Ophthalmological Society*, **75**, 22-54.

[3] Lie, I. and Watten, R.G. (1994) VDT Work, Oculomotor Strain, and Subjective Complaints: An Experimental and Clinical Study. *Ergonomics*, **37**, 1419-1433. https://doi.org/10.1080/00140139408964919

[4] Tatsukawa, Y., Nanba, T., Suematsu, O., Setoguchi, N. and Tabuchi, A. (2005) Immediate Effects of Horizontal/Vertical Eye Movements Playing Personal Computer Games on Visual Function. *Kawasaki Medical Welfare Journal*, **14**, 313-321. https://doi.org/10.15112/00012748

[5] Honaker, J.A. and Shepard, N.T. (2011) Use of the Dynamic Visual Acuity Test as a Screener for Community-Dwelling Older Adults Who Fall. *Journal of Vestibular Research*, **21**, 267-276. https://doi.org/10.3233/ves-2011-0427

[6] Pan, S., Nie, Q., Tai, H., Song, X., Tong, Y., Zhang, L., *et al.* (2022) Tea and Tea Drinking: China's Outstanding Contributions to the Mankind. *Chinese Medicine*, **17**, Article No. 27. https://doi.org/10.1186/s13020-022-00571-1

[7] Sugita, Y. and Furukawa, T. (2022) Effect of Green Tea and Tea Catechin on the Visual Motion Processing for Optokinetic Responses in Mice. *Neuroscience*, **501**, 42-51. https://doi.org/10.1016/j.neuroscience.2022.08.013

[8] Sugita, Y. (2025) Tea Catechins and Visual Motion Processing. In: Preedy, V.R. and Patel, V.B., Eds., *Tea in Health and Disease Prevention*, Elsevier, 771-781. https://doi.org/10.1016/b978-0-443-14158-4.00075-0

[9] Cabrera, C., Artacho, R. and Giménez, R. (2006) Beneficial Effects of Green Tea—A Review. *Journal of the American College of Nutrition*, **25**, 79-99. https://doi.org/10.1080/07315724.2006.10719518

[10] Chu, K.O., Chan, K.P., Wang, C.C., Chu, C.Y., Li, W.Y., Choy, K.W., *et al.* (2010) Green Tea Catechins and Their Oxidative Protection in the Rat Eye. *Journal of Agricultural and Food Chemistry*, **58**, 1523-1534. https://doi.org/10.1021/jf9032602

[11] Costa, B.L.D.S.A.D., Fawcett, R., Li, G., Safa, R. and Osborne, N.N. (2008) Orally Administered Epigallocatechin Gallate Attenuates Light-Induced Photoreceptor Damage. *Brain Research Bulletin*, **76**, 412-423. https://doi.org/10.1016/j.brainresbull.2008.01.022

[12] Falsini, B., Marangoni, D., Salgarello, T., Stifano, G., Montrone, L., Di Landro, S., *et al.* (2009) Effect of Epigallocatechin-Gallate on Inner Retinal Function in Ocular Hypertension and Glaucoma: A Short-Term Study by Pattern Electroretinogram. *Graefe's Archive for Clinical and Experimental Ophthalmology*, **247**, 1223-1233. https://doi.org/10.1007/s00417-009-1064-z

[13] Cheong, A., Siong, K.H., Tsang, W. and Chan, H.L.H. (2013) Relationship between Dynamic Vision and Balance in Older Adults. *Investigative Ophthalmology & Visual Science*, **54**, 1526.

[14] Tyler, S.L., Maltby, J., Paterson, K.B. and Hutchinson, C.V. (2022) Reduced Vision-Related Quality of Life in Dementia: A Preliminary Report. *Journal of Alzheimer's Disease*, **87**, 239-246. https://doi.org/10.3233/jad-215435

[15] Kaido, M., Fukui, M., Kawashima, M., Negishi, K. and Tsubota, K. (2020) Relationship between Visual Function and Cognitive Function in the Elderly: A Cross-Sectional Observational Study. *PLOS ONE*, **15**, e0233381. https://doi.org/10.1371/journal.pone.0233381

[16] Yoshida, K., Sakai, O., Honda, T., Kikuya, T., Takeda, R., Sawabe, A., *et al.* (2023) Effects of Astaxanthin, Lutein, and Zeaxanthin on Eye-Hand Coordination and Smooth-Pursuit Eye Movement after Visual Display Terminal Operation in Healthy Subjects: A Randomized, Double-Blind Placebo-Controlled Intergroup Trial. *Nutrients*, **15**, Article 1459. https://doi.org/10.3390/nu15061459

[17] Haga, T. (2014) Iyakuhin Kaihatsu no Tame no Tokei Kaiseki Dai 2-Bu Jikken Keikakuho. Scientist Press, 144-145.

[18] Tanaka, J. (1989) Fatigue Caused by Visual Display Terminal Work: An Experimental Investigation. *Hiroshima Journal of Medical Sciences*, **38**, 69-74.

[19] Nakamura, M., Tanaka, M. and Kudou, D. (2005) Effects of Aging and Regular Exercise on the Visual Functions. *Juntendo Medical Journal*, **51**, 153-159. https://doi.org/10.14789/pjmj.51.153

[20] Kang, Q. and Yang, C. (2020) Oxidative Stress and Diabetic Retinopathy: Molecular Mechanisms, Pathogenetic Role and Therapeutic Implications. *Redox Biology*, **37**, Article ID: 101799. https://doi.org/10.1016/j.redox.2020.101799

[21] Daniel, A., Premilovac, D., Foa, L., Feng, Z., Shah, K., Zhang, Q., *et al.* (2021) Novel Short-Chain Quinones to Treat Vision Loss in a Rat Model of Diabetic Retinopathy.

International Journal of Molecular Sciences, **22**, Article 1016. https://doi.org/10.3390/ijms22031016

[22] Ide, K., Yamada, H., Takuma, N., Park, M., Wakamiya, N., Nakase, J., *et al.* (2014) Green Tea Consumption Affects Cognitive Dysfunction in the Elderly: A Pilot Study. *Nutrients*, **6**, 4032-4042. https://doi.org/10.3390/nu6104032

[23] Baba, Y., Takihara, T., Kaneko, T. and Sagesaka, Y. (2019) Effects of a Daily Intake of Matcha on Cognitive Function in Middle-Aged and Older Subjects—A Place-Bo-Controlled, Randomized, Double-Blind, Parallel-Group Study. *Japanese Pharmacology & Therapeutics*, **47**, 1689-1702.