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Cognitive Control and Oculomotor Performance in Tension-Type Headache and Migraine: Saccadometry Findings

Migren ve Gerilim Tipi Baş Ağrısında Bilişsel Kontrol ve Okülomotor Performans: Sakkadometri Bulguları

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ABSTRACT Objective: The aim of this study was to comparatively evaluate antisaccade and prosaccade eye movements using saccadometry method in individuals diagnosed with tension-type headache (TTH) and migraine and to investigate the effect on cognitive control and executive function processes. **Materials and Methods:** The study included 29 GTBA patients, 29 migraine patients and 29 healthy control subjects. Antisaccade and prosaccade tests were performed using Video Nystagmography (VNG) system. Parameters analyzed included latency, velocity, accuracy and directional error rate. **Results:** In the antisaccade task, latency increased significantly (p = 0.0001), accuracy decreased (p = 0.002) and directional error rate increased (p = 0.0001) in both migraine and GTBA groups. Latency duration and directional error rate were higher in the migraine group compared to the GTBA group (p = 0.0001). In addition, both patient groups showed lower performance in the antisaccade velocity parameter compared to the control group (p = 0.008). No significant difference was found between migraine and GTBA groups. In the prosaccade task, no significant difference was found between the groups (p>0.05). **Conclusion:** Saccadometry, especially through antisaccade tasks, may be an alternative effective tool for the objective assessment of executive dysfunction in patients with TTH and migraine. Integration of saccadometry into VNG test batteries may support a multidisciplinary assessment approach between audiology, neurology and otolaryngology.

Keywords: Tension-type headache; migraine; saccadometry; cognitive control; antisaccade

ÖZET Amaç: Bu çalışmanın amacı, gerilim tipi baş ağrısı (GTBA) ve migren tanısı almış bireylerde sakkadometri yöntemi kullanılarak antisakkad ve prosakkad göz hareketlerinin karşılaştırmalı olarak değerlendirilmesi ve bilişsel kontrol ile yürütücü işlev süreçlerindeki etkilenimin araştırılmasıdır. **Gereç ve Yöntemler:** Çalışmaya; 29 GTBA hastası, 29 migren hastası ve 29 sağlıklı kontrol bireyi dâhil edilmiştir. Antisakkad ve prosakkad testleri video nistagmografi (VNG) sistemi kullanılarak gerçekleştirilmiştir. Bilişsel işlevler, yürütücü kontrol, inhibisyon ve dikkat gibi süreçlerle ilişkili olduğu bilinen antisakkad testi aracılığıyla dolaylı olarak değerlendirilmiştir. Analiz edilen parametreler arasında latans, hız, doğruluk ve yönsel hata oranı yer almıştır. İstatistiksel karşılaştırmalar için varyans analizi ve Kruskal-Wallis testleri ile Bonferroni düzeltmeleri uygulanmıştır. **Bulgular:** Antisakkad görevinde hem migren hem de GTBA gruplarında latans (p=0,0001) anlamlı şekilde artmış, doğruluk oranı (p=0,002) azalmış ve yönsel hata oranı (p=0,0001) artmıştır. Migren grubunda latans süresi ve yönsel hata oranı GTBA grubuna kıyasla daha yüksek bulunmuştur (p=0,0001). Ayrıca, antisakkad hız parametresinde de her iki hasta grubu kontrol grubuna göre daha düşük performans sergilemiştir (p=0,008). Migren ve GTBA grupları arasında anlamlı fark saptanmamıştır. Prosakkad görevinde latans, hız, doğruluk ve yönsel hata parametrelerinde gruplar arasında anlamlı bir fark bulunmamıştır (p>0,05). **Sonuç:** Sakkadometri, özellikle antisakkad görevleri aracılığıyla, GTBA ve migren hastalarında yürütücü işlev bozukluklarının objektif değerlendirilmesinde alternatif etkili bir araç olabilir. Sakkadometrinin VNG test bataryalarına entegrasyonu, odyoloji, nöroloji ve kulak burun boğaz disiplinleri arasında multidisipliner bir değerlendirme yaklaşımını destekleyebilir.

Anahtar Kelimeler: Gerilim tipi baş ağrısı; migren; sakkadometri; bilişsel kontrol; antisakkad

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Tension-type headache (TTH) and migraine are the predominant forms of headache globally. Migraine is generally defined by unilateral, pulsating pain. It may present with symptoms including nausea, photophobia, and phonophobia.[1] TTH is generally characterized by bilateral, pressing or constricting pain and is linked to less severe symptoms.[2,3]

The pathophysiology of migraine has been largely elucidated by neuroimaging studies; structural and functional changes in the brain stem, cerebellum, and frontal and parietal lobes have been revealed.[4,5] The pathogenesis of TTH is still unclear. However, decreased gray matter volume has been reported in brain regions involved in pain processing, such as the anterior cingulate and insula, and these findings have suggested that TTH may be related to central sensitization mechanisms.[3,6]

Both headache disorders can become chronic over time and may lead to secondary impairments in cognitive processes such as attention, executive functions, and inhibition due to the impact of psychiatric symptoms.[7] While these effects have been well documented in migraine patients, similar effects have been reported in chronic TTH patients in relation to pain duration, frequency, and accompanying psychological symptoms.[7,8]

Moreover, it has been shown that various cognitive functions may also be affected in individuals with migraine and TTH. Assessments conducted using tools such as the Montreal Cognitive Assessment (MoCA), Rey-Osterrieth Complex Figure Test, Trail Making Test (TMT), and digit span tasks have reported performance impairments in domains such as attention, memory, executive functions, and orientation.[7,9-11] These findings suggest that headache disorders are not limited to pain symptoms alone but may also be associated with cognitive dysfunction.

Pain processing and the mechanism of saccade formation are largely mediated through common neuroanatomical structures such as the frontal cortex, cingulate gyrus, brainstem and basal ganglia.[12-14] In line with this partnership, the saccadometry method, which enables the objective assessment of eye movements, stands out as an easy-to-use, simple, practical and low-cost assessment tool that is promising in examining the neurocognitive effects of headache disorders. In fact, saccadometry has been integrated into video-nystagmography (VNG) systems and included in vestibular test batteries by some manufacturers recently.[11,15-18]

Saccadometry provides information about antisaccade tasks and attentional control, executive functions, and response inhibition by analyzing parameters such as latency duration, speed, accuracy, and error rate of saccades, which are rapid eye movements. Prosaccade tasks evaluate reflexive eye movements. The method has been previously used in clinical conditions such as Alzheimer's disease', Parkinson's disease', attention autism and deficit hyperactivity disorder, and has made a significant contribution to clinical assessment.[19-22]

Studies comparing antisaccade and prosaccade parameters using saccadometry in people with migraine and TTH are not, as far as we are aware, available in the literature. Our aim was to examine cognitive performance related to attention, response inhibition, and executive functions by assessing saccadic eye movements through prosaccade and antisaccade tasks in patients with migraine and TTH. In addition, to investigate whether there are neurocognitively distinctive differences between the 2 headache types. In this context, it is thought that studies to reveal the neurocognitive discrimination of saccadometry method in these disorders will make significant contributions to the literature.

MATERIAL AND METHODS

ETHICAL APPROVAL

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and the principles of Good Clinical Practice. On May 26, 2023, the University of Health Sciences' Hamidiye Scientific Research Ethics Committee approved the research protocol, which was registered under registration number 23/341. Before beginning the study, each participant voluntarily signed the informed consent form.

PARTICIPANTS

The study groups consisted of 29 migraine patients (39.76±10.3), 29 GTBA-type headache patients

(34.85±13.4), and healthy control subjects (38.08±11.6). The sample size was determined using the G*Power 3.1 software (Heinrich Heine University Düsseldorf, Department of Psychology, Germany), predicated on a medium impact size of 0.5 and a 5% margin of error to guarantee a minimum power of 90%. The research was performed using subjects referred from the Neurology Clinic of the Health Sciences University Ümraniye Training and Research Hospital.

Patients were selected by a neurologist based on their cognitive performance, as evaluated by the Mini-Mental State Examination (MMSE), to exclude those with significant cognitive impairment, and the diagnostic criteria of The International Classification of Headache Disorders.[16,23] The research involved participants monitored for a minimum of 2 years, all diagnosed with migraine and TTH, experiencing 1 or 2 episodes monthly. Furthermore, equilibrium across the groups was maintained to guarantee that the educational attainment and sociocultural attributes of the participants were comparable.

Audiologic evaluations and oculomotor tests were performed to determine the eligibility criteria. All tests were conducted by research audiologists in accordance with standard protocols.

The control group comprised individuals without a history of headaches, neurological problems, or regular medication usage.

EXCLUSION CRITERIA AND INCLUSION CRITERIA

- To be between the ages of 18-55,
- To have the cognitive and physical competence to complete the tests for voluntary saccadic eye movements in cooperation and in a complete manner.
- To have no headache attack at the time of the test,
- Not receiving preventive treatment in the last 3 months
- Not taking any medication that may affect saccadic eye movements
- To have no history of any neurological or systemic disease other than the diagnosis
- According to the pure tone audiometry results, hearing is within the normal limits for age.
- MMSE score score ≤22).[16]

Inclusion Criteria for Migraine:

- Being diagnosed with migraine for at least 2 years
- Having at least 5 attacks,
- Each attack lasting 4-72 hours without treatment or with ineffective treatment,
- Attacks having at least two characteristics: unilateral location, throbbing character, moderate or severe severity, and worsening with physical activity.
- Attacks accompanied by at least one accompanying symptom: nausea/vomiting or photophobia and phonophobia.

Inclusion Criteria for TTH-type headache:

- At least 1-14 attacks,
- Duration of attacks between 30 minutes and 7 days,
- The headache must meet at least 2 of the following criteria: bilateral localization, compressive/straining character, mild or moderate severity, and not worsened by physical activity.
- No nausea or vomiting, only photophobia or phonophobia but not both.

Exclusion Criteria

- Severe visual impairment or functional impairment in the oculomotor system
- History of psychiatric or neurological disorders (e.g., epilepsy, schizophrenia, multiple sclerosis, etc.),
- Hearing loss (outside the normal values for age by pure tone audiometry),
- Having a headache attack during the test,
- Musculoskeletal disorders that may prevent head and neck movements,
- Temporary impairment in cognitive functions due to alcohol or drug use
- Lack of sleep, excessive fatigue, or other temporary conditions that may cause distraction on test day.[23]

Procedures

■ Speech audiometry and pure tone audiometry were performed using a clinical audiometer (Madsen Astera; Denmark) conforming to Industrial Acoustic Company (IAC) standards.

■ Tympanometric evaluation (226 Hz) and stapedial reflex measurements were performed using a Madsen Otoflex 100; Denmark tympanometer.

■ All oculomotor assessments were performed using a VNG (Interacoustics VisualEyes™ 525 Denmark).

Saccadometry

Saccadic eye movement measurements were performed using a VNG system (Interacoustics VisualEyes™ 525; Denmark). All assessments were performed using the default test settings defined by the manufacturer. Participants were seated on a stretcher 1.2 m from the screen. In each trial, a red visual stimulus target was presented on a black background. This target was designed to occupy approximately 1% of the screen width and was displayed at a random position 10° left or right of the central fixation point after a delay of 1.5 s on average (randomly varying between 1-2 seconds).

The tests were performed in the horizontal plane. Video oculography goggles were calibrated at the beginning of the session to ensure accurate recording of eye movements. To minimize response-related artifacts, the participants were instructed to keep their heads still, keep their eyes open, and follow the test instructions carefully.

In the prosaccade test, a center-fixed dot was illuminated, followed by flashing a new target at a random location. Participants were asked to look quickly at this new target and then return their gaze to the center point. In the antisaccade test, participants were instructed to initially focus on a central point; when a new target appeared, they were instructed to look in the opposite direction of the new target and then focus back on the center. Each test was administered in blocks of 100 saccades (50 right, 50 left) with stimuli lasting 251 milliseconds. A block trial is defined as a structure in which only one saccadic task type (prosaccade or antisaccade) is tested in each session.[24]

The following saccadic parameters were calculated and analyzed using the testing software:

■ **Velocity (°/s):** Speed of eye movement between 2 points.

■ **Latency (ms):** Time from stimulus onset to initiate eye movement.

■ **Accuracy (%):** Degree to which the eye movement reaches the target.

■ **Directional error rate (%):** % of saccades made in the wrong direction.[24]

A diagram of antisaccadic and prosaccadic movements is shown in Figure 1.

For each parameter, the data obtained from the right and left eyes were averaged and used in the analyses. Participants were questioned about the presence of any factors that might affect mental performance, such as illness, fatigue, or sleep deprivation.[25] To ensure standardized testing conditions, individuals identified as having such conditions were excluded from the study.

STATISTICAL METHOD

The IBM SPSS 26.0 (IBM Corp., Armonk, NY, ABD) package program was used in the statistical analysis of the study. Descriptive statistics (frequency, percentage, median, minimum-maximum values, mean, standard deviation) were calculated for the demographic data of the migraine, TTH, and control groups and measurements related to the antisaccade and prosaccade tasks. In the comparison of prosaccade and antisaccade measurements between the groups, analysis of variance (ANOVA) test was used for normally distributed parameters and Kruskal-Wallis test was used for non-normally distributed parameters. For the parameters with significant differences because of the Kruskal-Wallis test, pairwise comparisons between groups were performed using Mann-Whitney U test with Bonferroni correction. All statistical analyses were performed at 95% confidence interval and significance was evaluated at $p<0.05$.

RESULTS

The mean age of the TTH group was 34.85±13.4, the youngest was 20 and the oldest was 49; the mean age

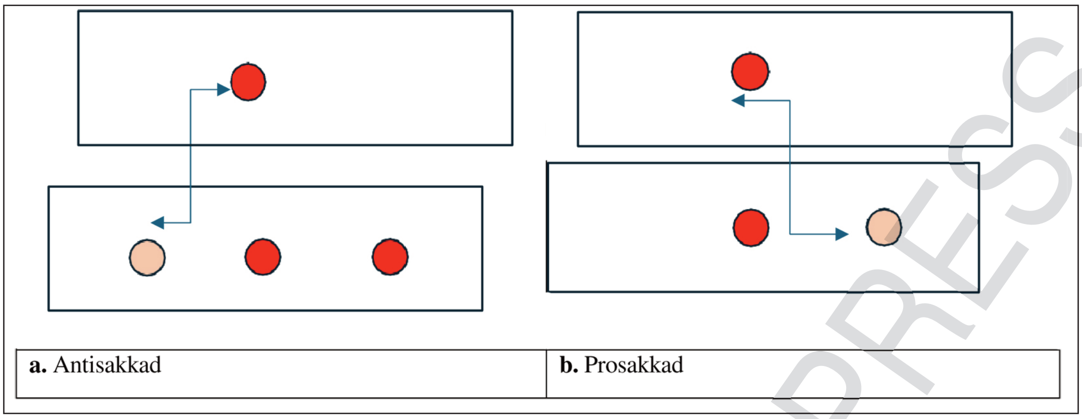

FIGURE 1: There is a red dot that is constantly lit in the center. The light-colored dot is the randomly lit target dot. In the antisaccade test, the participant is asked to first look at the central point and then look at the empty space symmetrical to the target point without looking at the second red point that is lit. After that, they are asked to look at the central point again. In the prosaccade test, the participant is asked to look at the central point, then at the target point, and then back at the central point again.[17]

of the migraine group was 39.76±10.3, the youngest was 21 and the oldest was 47; and the mean age of the control group was 38.08±11.6, the youngest was 25 and the oldest was 46. There was no statistically significant difference between the groups in terms of age (Kruskal-Wallis test; $p>0.05$). In the TTH group, 26 (89.7%) were female and 3 (10.3%) were male; in the migraine group, 27 (93.1%) were female and 2 (6.9%) were male; and in the control group, 25 (86.2%) were female and 4 (13.8%) were male. There was no statistically significant difference between the groups in terms of gender distribution (chi-square test; $p>0.05$) (Table 1).

There was no statistically significant difference between the TTH, migraine, and control groups in terms of the mean latency, mean speed, mean accuracy, and directional error (%) of prosaccad (Kruskal-Wallis test; $p>0.05$).

There was a statistically significant difference in the antisaccade mean latency between the TTH, migraine and control groups participating in the study. (Kruskal-Wallis test; H=25.629; $p=0.0001<0.01$) This difference was caused by the differences between the Antisaccade mean latency scores of the TTH and migraine (migraine>TTH; Mann-Whitney U test, U=121; Z=-3,847; $p=0.0001<0.01$) and migraine and control (migraine>control; Mann-Whitney U test, U=77; Z=-4.572; $p=0.0001<0.01$) groups.

There was a statistically significant difference between the TTH, migraine, and control groups in terms of the antisaccade mean speed. (Kruskal-Wallis test; H=9.616; $p=0.008<0.01$) This difference was caused by the differences between the antisaccade mean speed scores of the TTH and control (TTH>control; Mann-Whitney U test, U=171.5; Z=-2.894; $p=0.004<0.01$) and migraine and control (migraine>control; Mann-Whitney U test, U=186; Z=-2.456; $p=0.014<0.05$) groups (Table 2).

TABLE 1: Distribution of demographic data of participants according to the groups

Demographic data	TTH group n=29	Migraine group n=29	Control group n=29	p value
Median (minimum-maximum) X̄±SD				
Age	32.5 (20-49) 34.85±13.4	40 (21-47) 39.76±10.3	35 (25-46) 38.08±11.6	0.215[1]
n (%)				
Gender				
Female	26 (88.5)	27 (93.1%)	25 (86.2%)	0.412[2]
Male	3 (11.5)	2 (6.9%)	4 (13.8%)	

[1]Kruskal-Wallis test; [2]Ki-kare test; **$p<0.01$. SD: Standard deviation

TABLE 2: Comparison of prosaccade and antisaccade parameters between the TTH-type headache, migraine, and control groups

	TTH group n=29			Migraine group n=29			Control group n=29			
	Median	Minimum-maximum	$\bar{X}$±SD	Median	Minimum-maximum	$\bar{X}$±SD	Median	Minimum-maximum	$\bar{X}$±SD	p value
Prosaccade										
Latency	237	186-288	238.62±31.7	252	27-347	241.96±62.8	250	193-310	244.8±28.9	0.7172
Velocity	268	259-301	275.96±14.6	277	227-296	269.56±21.6	268	259-301	276.32±14.8	0.7542
Accuracy	97	84-100	95.46±4.1	98	88-109	98.36±5.1	97	86-102	95.8±5.1	0.1032
Directional error (%)	0.5	0-1	0.5±0.5	0	0-5	1.12±1.5	0	0-4	0.56±1	0.4332
Antisaccade										
Latency	350	267-402	344.73±34.8	394	347-522	402.96±51.5	329	247-425	330.08±46.4	0.0001**[2]
Velocity	250	198-339	257.38±41.2	244	180-356	257.32±47.6	214	167-357	225.52±44.5	0.008**[2]
Accuracy	97	71-214	107.88±36.2	112	69-127	104.4±20.2	84	59-125	85.84±17.1	0.002**[2]
Directional error (%)	16.5	2-27	14.12±7.9	24	9-53	25.48±13	5	0-18	6.36±4.6	0.0001**[1]

[1]Analysis of variance; [2]Kruskal-Wallis test; **p<0.01. SD: Standard deviation

There was a statistically significant difference between the TTH, migraine and control groups participating in the study in terms of the antisaccade mean accuracy. (Kruskal-Wallis test; H=12.499; p=0.002<0.01) This difference was caused by the differences between the antisaccade mean correct scores of the TTH and control (TTH>control; Mann-Whitney U test, U=162; Z=-3.075; p=0.002<0.01) and migraine and control (migraine>control; Mann Whitney U test, U=157.5; Z=-3.01; p=0.003<0.01) groups.

There was a statistically significant difference between the TTH, migraine, and control groups in terms of the antisaccade directional error (%) (ANOVA; F=27,574; p=0,0001<0,01). This difference is between the TTH and migraine (migraine>TTH; Bonferroni correction, p=0,0001<0,01), TTH and control (TTH> control; Bonferroni correction, p=0.01<0.05) and migraine and control (migraine>control; Bonferroni correction, p=0.0001<0.01) groups.

The results of the antisaccade and prosaccade tasks from the saccadometry test are presented in Figure 2.

DISCUSSION

The study revealed differences in cognitive control and executive dysfunctions by evaluating antisaccade and prosaccade eye movements in individuals with migraine and TTH. The results showed that in the antisaccade task, both the migraine and THA groups had significantly longer latency durations, increased directional error rates, and decreased accuracy rates compared to the control group. In addition, the latency duration and directional error rate were significantly higher in the migraine group than in the TTH group. In terms of the speed parameter, a decrease was observed in both patient groups compared to the control group, but no significant difference was found between the TTH and migraine groups. On the other hand, no significant difference was found between the migraine, TTH, and control groups in the latency, speed, accuracy, and directional error parameters of the prosaccade task.

In the literature, reflexive saccade performance has been evaluated in both the migraine group and the TTH group.[26] The findings suggest that the oculomotor system based on basic reflexive eye movements may be preserved in the patient groups.[15,27] In our study, performance on the prosaccade task, which assesses reflexive eye movements, was similar between the TTH and migraine groups com-

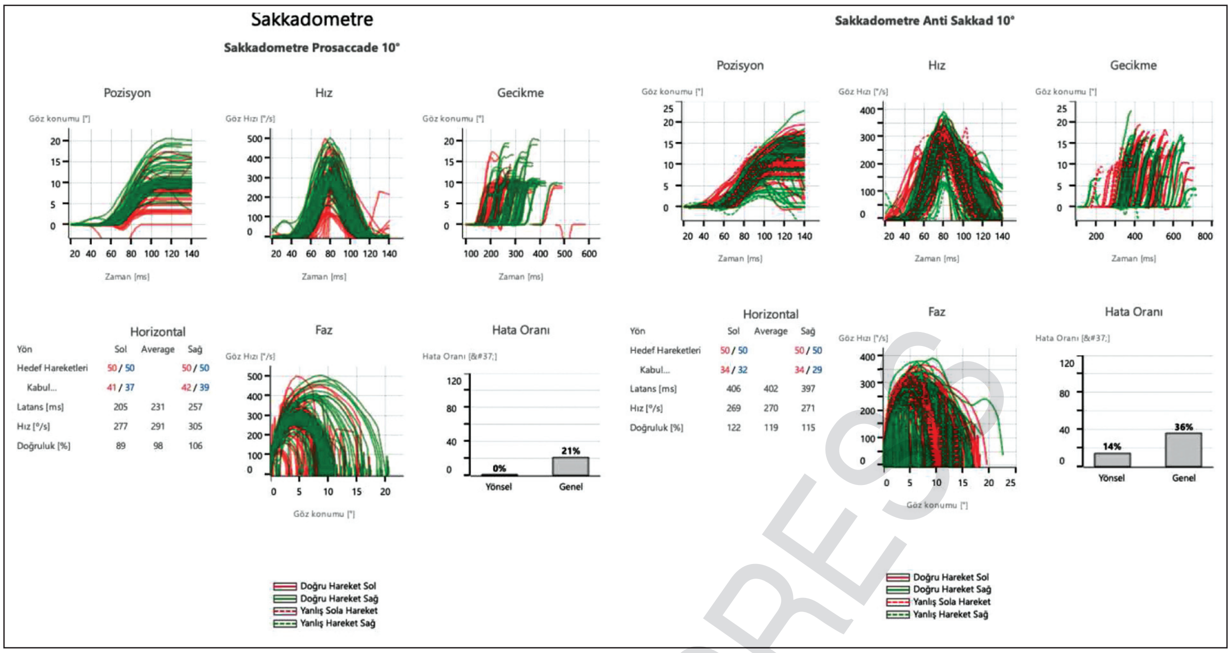

FIGURE 2: The figure presents representative waveforms of presaccadic eye movements, including the position, velocity, and latency graphs. The green traces indicate correct responses, while the red traces represent erroneous or deviated saccades. The top-left panel shows eye position over time, the center panel shows eye velocity, and the top-right panel displays the response latency. In the lower section, a table summarizes the horizontal (left-right) target movements, the number of accepted saccades, and the mean latency, velocity, and accuracy percentages. The phase plot illustrates the relationship between the eye position and velocity. The bottom-right graph shows the directional and overall error rates.

pared with the control group. This finding suggests that the reflexive saccadic system is largely preserved in the TTH and migraine groups and that both groups perform within normal limits in less cognitively complex tasks. Previous studies have also reported that eye movements that do not require cognitive control can be at the level of healthy individuals, especially in migraine patients.[17,28,29]

The antisaccade paradigm represents more complex cognitive processes compared to the prosaccade task. In this task, voluntary eye movement in the direction opposite to the visual stimulus requires the suppression of the reflexive gaze impulse and the activation of high-level cognitive control mechanisms.[12] Successful execution of these processes requires healthy functioning of the prefrontal networks, particularly the dorsolateral prefrontal cortex (DLPFC) and frontal eye fields (FEF).[12,15,30-32] Disorders in structures such as DLPFC and FEF may lead to increased error rates and prolonged latencies in the antisaccade task.

The antisaccade performance impairments observed in the migraine group in our study are consistent with those in previous studies. Cambron et al. and Filippopulos et al. reported that migraine patients made more errors and exhibited prolonged latencies in the antisaccade task compared with healthy individuals.[26,28] Our findings also support studies that point to weakened functional connections between sensorimotor regions and other brain structures in migraineurs.[7,33] High directional error rates and prolonged latency durations indicate coordination disorders between the prefrontal cortex and related networks in patients with migraine. In addition, it has been reported in the literature that gray matter losses are detected in migraine patients and these losses are associated with disruptions in attention and inhibition processes.[26] There is a consistent relationship between our findings and those of previous studies; it is thought that the changes caused by migraine in brain networks are reflected in antisaccade performance.

Although TTH is generally thought to be a type of headache associated with more peripheral mechanisms (e.g., muscle tension and myofascial triggers) than migraine, central nervous system changes have been demonstrated in this patient group in recent years.[3,34] In chronic TTH patients, gray matter reduction was found in brain regions associated with pain processing; it was emphasized that these structural changes were specific to TTH rather than a secondary adaptation to chronic pain. Gray matter reduction in pain-related brain regions has been reported in chronic TTH patients, and it has been emphasized that these changes are specific to TTH.[8] In our study, the lower performance of the TTH group in the antisaccade task compared with the control group indicates the presence of a certain level of involvement in attention, inhibition and executive functions in this patient group. However, the better performance of the TTH group compared with the migraine group suggests that the level of neurocognitive involvement is milder. Previous research has shown that the cognitive impairment observed in TTH is largely due to central changes related to chronic pain, whereas in migraine patients, the impairment is more widespread and profound. It has been reported that migraine is associated with cortical hyperexcitability, neurovascular dysfunction, and accompanying neuropsychiatric symptoms (such as anxiety, depression, and sleep disorders); these conditions may affect antisaccade performance more negatively.[35,36] Therefore, the fact that the prefrontal systems were less affected in the TTH group compared with the migraine group may contribute to the relative preservation of antisaccade performance. Indeed, it is emphasized in the literature that, unlike migraine, there is no significant cognitive impairment in the non-attack period in other primary headaches such as TTH and cluster headache.[37] The fact that the increase in central nervous system sensitivity in TTH is mostly limited to pain modulation may explain the relative preservation of executive functions.[6] This provides an important clue to understanding the mechanisms underlying the neurocognitive differences between TTH and migraine.

The MoCA, Rey-Osterrieth Complex figure test, and TMT were administered to individuals with TTH and migraine, and evaluations were made using numerical memory tests.[10,11,38] It has been reported that migraine patients exhibit lower performance compared with healthy controls in areas such as executive functions, language, memory, and calculation. Similarly, patients with TTH have been observed to have lower cognitive performance, particularly in the areas of attention and memory. However, some studies have reported that TTH causes less pronounced cognitive effects than migraine.[9,10,37] These findings support the results of our study.

LIMITATIONS

First, the sample size was relatively small, which limits the generalizability of the findings. In addition, the study relied solely on behavioral metrics derived from saccadic eye movements, without incorporating direct neuroimaging data to assess underlying neural activity or regional brain function. This represents a limitation in explaining the neurobiological mechanisms behind the observed findings. Furthermore, cognitive impairment was evaluated exclusively through saccadic parameters, without the use of validated neuropsychological assessments widely accepted in the literature. Therefore, the direct relationship between these eye movement features and cognitive deficits remains speculative. Future studies should incorporate standardized cognitive testing alongside saccadometry and include appropriate control groups to enable more robust and clinically meaningful interpretations.

CONCLUSION

This study evaluated the effects on cognitive control and executive function processes in patients with TTH and migraine by comparatively examining antisaccade and prosaccade eye movements using saccadometry test. The results showed that the TTH and migraine groups showed significantly impaired performance compared to the control group, especially in the antisaccade task. In the TTH group, similar but milder impairments were observed. On the other hand, there was no significant difference between the groups in the prosaccade task, suggesting that basic reflexive oculomotor functions were preserved.

In recent years, the integration of saccadometry tests into VNG systems by some manufacturers has increased the accessibility and diagnostic value of the test. The fact that antisaccadic tasks are closely related to high-level cognitive processes such as attention, inhibition and executive control makes this test not only a vestibular but also a neuropsychological assessment tool. In this context, saccadometry can be a multidisciplinary assessment tool between the fields of audiology, neurology, and otolaryngology.

In conclusion, saccadometry, especially through antisaccade tasks, stands out as an effective, objective and multidisciplinary test for the assessment of executive dysfunctions in patients with TTH and migraine. In this respect, its inclusion in the modern VNG test battery is thought to provide important contributions to both clinical decision-making processes and scientific research.

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Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

***Idea/Concept:** Asya Fatma Men; **Design:** Asya Fatma Men; **Control/Supervision:** Tuğba Yılmaz; **Data Collection and/or Processing:** Asya Fatma Men; **Analysis and/or Interpretation:** Tuğba Yılmaz; **Literature Review:** Asya Fatma Men; **Writing the Article:** Asya Fatma Men; **Critical Review:** Gülce Kirazlı.*

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