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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

Effects of Visual Field Changes on Gait and Balance

Görme Alanı Değişimlerinin Yürüme Analizi Üzerindeki Etkisi

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ABSTRACT

Introduction: The vision provides proprioceptive information about the relative positions of the movements of the body compared to the environment or a body portion. We aimed to see the effect of visual field changes on gait and balance to obtain results for proprioceptive power of vision and to determine whether there was any difference in visual information between the hemispheres.

Material and Method: Our study was conducted with 50 male subjects. The dominant extremity of the subjects were questioned. To measure gait and stance, we used © FDM System Type FDM 1,5 and Win FDM computer program. First, the normal gait and balance were measured. Then, the subjects were given a trial frame, half covered with black cardboard paper; and the measurements were repeated with up, down, right and left closed. The statistical significance limit was set at p <0,05.

Results: The changes in the visual field affected the balance, especially in the medial – lateral direction, and the left (dominant) hemisphere was more affected. There were differences in visual field changes between right and left hemisphere. It was seen that the lower part of the peripheral visual field was very important in gait.

Conclusion: More comprehensive studies are needed to better understand the difference between visual field changes and right – left hemisphere. The part where we close the right – left visual field of our study can be considered as the first study in literature as far as we can see.

Keywords: Visual field, proprioception, gait analysis, stance analysis

ÖZ

Giriş: Görme, çevreye veya bir vücut bölümüne kıyasla vücudun çeşitli kısımlarının hareketlerinin pozisyonları hakkında propriyoseptif bilgi sağlamaktadır. Çalışmamızda görme alanı değişikliklerinin yürüme ve denge üzerindeki etkisini görmek, görmenin propriyoseptif gücüne yönelik sonuçlar elde etmek ve her iki hemisfer arasında görsel bilgiyi değerlendirme yönünde fark olup olmadığını saptamayı hedefledik.

Gereç ve Yöntem: Yaptığımız çalışma 18-25 yaş aralığında 50 erkek deneğin katılımı ile gerçekleştirildi. Deneklerin boy ve kilo ölçümleri yapıldı, dominant ekstremite tarafı sorgulandı. Deneklerin yürüme ve statik denge analizleri Zebris © FDM System Type FDM 1,5 ve WinFDM bilgisayar programı kullanılarak gerçekleştirildi. Deneklerin ilk olarak normal yürüyüşleri ve dengeleri ölçüldü. Sonra deneklere yarısı siyah mukavva kağıdı ile kapatılmış olan gözlük camı deneme çerçevesi verildi ve ölçümler aşağı, yukarı, sağ ve sol kapalı olarak tekrarlandı. Elde edilen verilerin istatistiksel analizi için SPSS 20 programı kullanıldı. İstatistiksel anlamlılık sınırı p <0,05 olarak belirlendi.

Bulgular: Çalışmamızın verileri değerlendirildiğinde görme alanında yapılan değişiklikler ile yürüme parametreleri arasında belirgin fark olduğu görüldü. Kelebek diyagramında görülen değişiklikler için daha fazla çalışma gerektiği düşünüldü. Görme alanı değişikliklerinin dengeyi özellikle medial – lateral yönde etkilediği ve sol (dominant) hemisferin görme alanı değişikliklerinde daha fazla etkilendiği görüldü. Hemisferler arasında görme alanında yapılan değişikliklerde farklar olduğu saptandı. Periferik görme alanının alt kısmının yürümede oldukça önemli olduğu görüldü.

Sonuç: Görme alanı değişiklikleri ile sağ–sol hemisfer arasındaki farkın daha iyi anlaşılabilmesi için daha kapsamlı çalışmalar yapılması gereklidir. Çalışmamızın sağ–sol görme alanını kapatarak yaptığımız kısmı literatürde gördüğümüz kadarıyla yapılan ilk çalışma olarak kabul edilebilir.

Anahtar Sözcükler: Görme alanı, propriyosepsiyon, yürüme analizi, denge analizi

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Introduction

The term proprioception was first described by Charles Sherrington in 1906 as "perception of the position of the body or body parts as well as joint and body movements" (1,2). Proprioception, which generally acts on a subconscious level, is effective in the regulation of internal organs, balance and regulation of locomotor activities (1). Mechanoreceptors responsible for perception of proprioceptive information are found mainly in muscle, tendon, ligament and joint capsule; while

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it is assumed that the mechanoreceptors in the subcutaneous tissue and fasciae are related to tactile sensation and serve as an additional source for carrying proprioceptive information (3,4).

Proprioception has been shown to be impaired in cases where visual information is incorrect (vision defect or vision impaired glasses, etc.) or in the absence of complete visual stimulation (5,6).

Visual stimulation provides information about the events and objects in the environment as well as information about the relative positions of various parts of the body compared to the environment or part of the body. Therefore, vision is both an exteroceptive and a proprioceptive experience (6,7).

When a healthy individual wants to describe any part of the body relatively, it combines visual stimulation with proprioceptive information from that part of the body. It is very difficult for an individual to act with full accuracy without having visual information about the environment. For this reason, the individual strengthens the proprioception by making use of the exteroceptive effect of vision (6-8).

According to the researches, while the proprioceptive senses provide information for the stimuli coming from within the body, the visual sense provides information for the stimuli coming from outside the body. However, information from both senses comes together at a certain level and work together. How these two systems work together, one of which compiles information from the outside and the other from the inside, has not been fully clarified (7).

The aim of our study is to see the effects of visual field changes on gait and balance, to obtain results for the proprioceptive power of vision, and to determine whether there is a difference in evaluating visual information between both hemispheres.

Method

Before starting the measurements, ethical approval was received from Trakya University Faculty of Medicine Scientific Research Ethics Committee dated 02.04.2018 and numbered 06/02. Our study was carried out with the participation of 50 male volunteers between the ages of 18-25. Volunteers were selected exclusively for male gender in order to homogenize changes between male and female gender gait analysis. Volunteers who have any diseases that can effect vision, balance and gait were excluded.

Patterns of gait and balance analysis were determined using the force platform Zebris©, FDM System Type FDM 1,5 and WinFDM computer program. The force platform and the WinFDM computer program are interconnected systems that can measure the balance and gait analysis of a person standing in an upright position by detecting force distributions.

Gait analysis

Gait analysis was performed five times for each volunteer. In the first measurement, no changes were made in the visual field and normal gait was measured. For later measurements, the volunteers were given an Oculus trial frame. The trial frame was specially adjusted to the distance between the two eyes of each volunteer. Each part of the trial frame were divided into two equal parts. While one half of the frame is closed with a black cardboard, the other half is left open (Figure 1). After the first

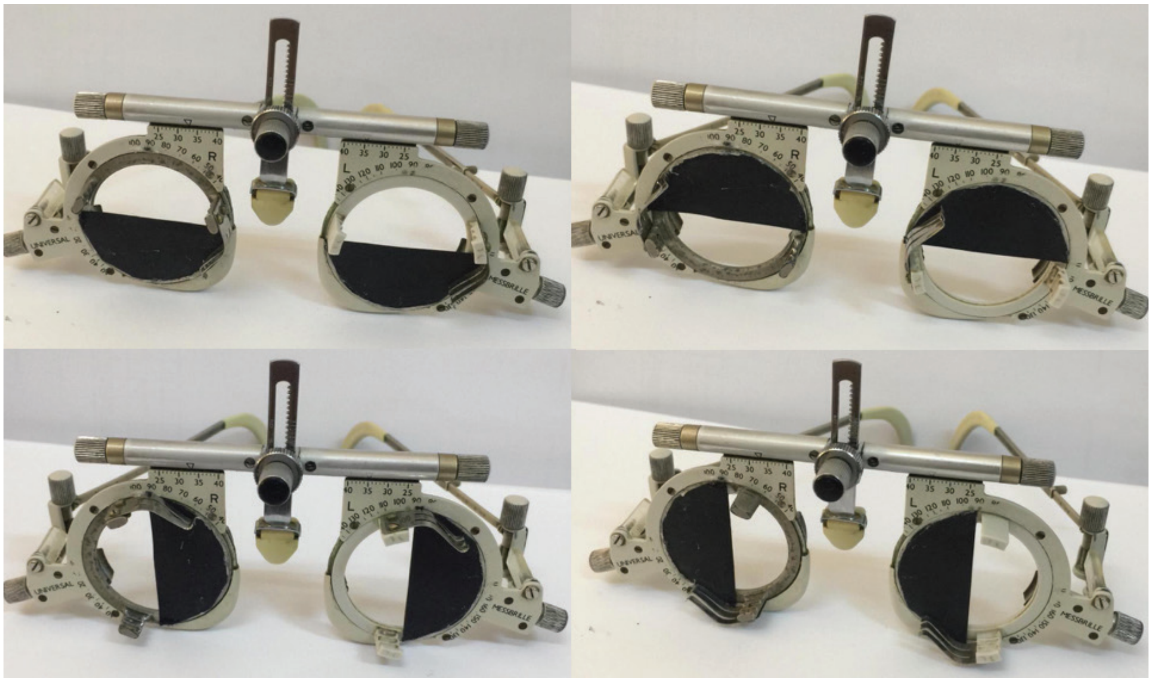


Figure 1. Oculus trial frame. The trial frame was specially adjusted to the distance between the two eyes of each volunteer. Each part of the trial frame were divided into two equal parts. While one half of the frame is closed with a black cardboard, the other half is left open. After the first measurement without trial frame; the right, left, down and up halves of the trial frame were closed for both eyes, respectively, and the measurements were repeated.

measurement without trial frame; the right, left, down and up halves of the trial frame were closed for both eyes, respectively, and the measurements were repeated. During gait analysis, volunteers were asked to walk on the platform at their natural speed, with eyes open, standing upright, eyes facing straight ahead, and arms freely swinging on both sides of the body.

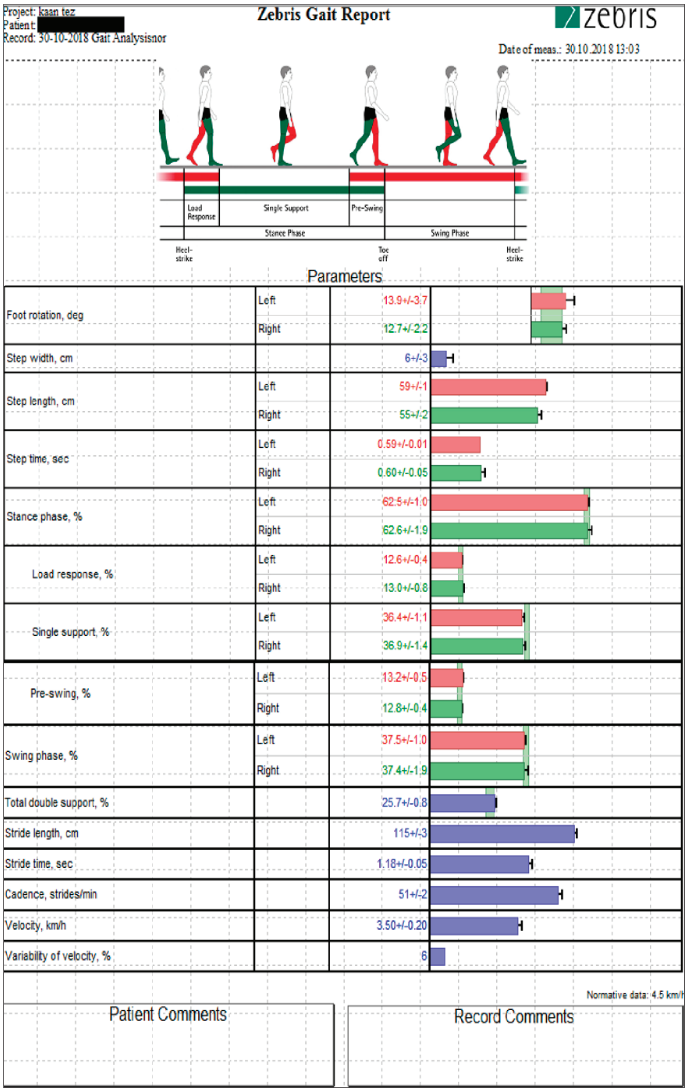
Balance analysis

Static balance analysis was performed ten times for each volunteer. Five of the balance analysis lasted 30 seconds while the other five were 60 seconds. The first of each 30 and 60 seconds balance analysis was without trial frame, and the remaining four were with glasses. Measurements made with trial frame were performed by closing the right, left, down and up halves, respectively, as in gait analysis. Subjects stood still on the force platform with both upper limbs extending forward, with their eyes open and facing straight ahead and looking at a visual placed at eye level.

Figure 2. The force platform Zebris©, FDM System Type FDM 1,5 and WinFDM computer program.

Figure 3. Gait analysis

Figure 4. Stance analysis



Project: kaan tez
Patient: [redacted]
Record: 30-10-2018 Gait Analysisnor

Zebris Gait Report

Date of meas.: 30.10.2018 13:03

Parameters

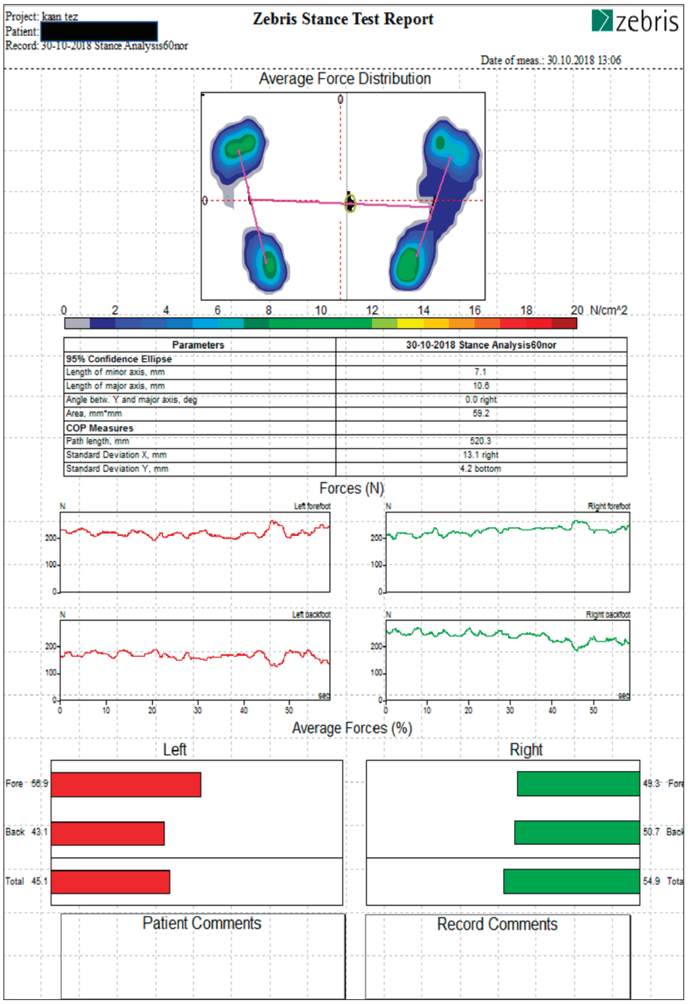
Foot rotation, deg	Left	13.9+/-3.7
	Right	12.7+/-2.2
Step width, cm		6+/-3
Step length, cm	Left	59+/-1
	Right	55+/-2
Step time, sec	Left	0.59+/-0.01
	Right	0.60+/-0.05
Stance phase, %	Left	62.5+/-1.0
	Right	62.6+/-1.9
Load response, %	Left	12.6+/-0.4
	Right	13.0+/-0.8
Single support, %	Left	36.4+/-1.1
	Right	36.9+/-1.4
Pre-swing, %	Left	13.2+/-0.5
	Right	12.8+/-0.4
Swing phase, %	Left	37.5+/-1.0
	Right	37.4+/-1.9
Total double support, %		25.7+/-0.8
Stride length, cm		115+/-3
Stride time, sec		1.18+/-0.05
Cadence, strides/min		51+/-2
Velocity, km/h		3.50+/-0.20
Variability of velocity, %		6

Normative data: 4.5 km/h

Patient Comments

Record Comments

Figure 5. Gait analysis parameters.



Project: kaan tez
Patient: [redacted]
Record: 30-10-2018 Stance Analysis60nor

Zebris Stance Test Report

Date of meas.: 30.10.2018 13:06

Parameters	30-10-2018 Stance Analysis60nor
95% Confidence Ellipse	
Length of minor axis, mm	7.1
Length of major axis, mm	10.6
Angle betw. Y and major axis, deg	0.0 right
Area, mm*mm	59.2
COP Measures	
Path length, mm	520.3
Standard Deviation X, mm	13.1 right
Standard Deviation Y, mm	4.2 bottom

Figure 6. Stance analysis parameters.

Statistical analysis

Results are shown as mean ± standart deviation and number (%). The suitability of quantitative data for normal distribution was tested with the Shapiro-Wilk test. ANOVA test was used for the comparison of five different measurements with normal distribution, and Freidman test was used for comparion of those without normal distribution. In the comparison of the 30 and 60 second measurements, paired t test was used for variables with normal distribution and Wilcoxon test was used for those without normal distribution. P<0,05 value was accepted as statistical significance limit value.

Results

While 45 of the subjects were right dominant, 5 were left dominant. Average values and standart deviations of the anthropometric data of the subjects are given in Table 1.

Table 1. Demographic and anthropometric features of subjects.

	Volunteers (n:50)
Age (year)	20,14±1,41
Height (cm)	178,57±5,21
Weight (kg)	76,08±9,7
BMI (kg / m²)	23,85±2,79

BMI: Body mass index.

The normal (N), left closed (LC), right closed (RC), down closed (DC) and up closed (UC) measurements were compared.

There was a significant difference between some groups in gait analysis data (Table 2).

A significant difference was observed between some groups in the parameters of the 30-second and 60-second static balance analyzes (Table 3 and 4).

The data obtained from the 30 ve 60 second static balance analyzes that showing the same parameter were compared as a group. There was a significant difference between some groups (Table 5).

Discussion

We aimed to investigate the effects of changes in visual field on gait and balance, and the relationship of this effect with proprioception. There are studies conducted with many different methods investigating the effect of vision on gait and balance (9-17). We preferred to perform the gait and balance analysis with the force platform. We used the trial frame to create visual field changes.

The step length was the lowest measured as DC. There was a significant difference in left step length between RC-DC; and in right step length between LC-DC.

The lowest measured value for stride length was in DC. The highest difference was between N-DC. Also, there was a significant difference between RC-DC.

Hallemans et al. (9) investigated how vision deficiency affects gait. They made two groups, one including healthy subjects and the other one including subjects with visual defects. Healthy subjects were measured without glasses first, and then with glasses covered with black tape. In this way, it was desired to create an artificial blindness. They found that individuals with visual defects showed shorter stride length. The same result was observed in the subjects, which were measured by creating artificial blindness. The subjects with artificial blindness also experienced a decrease in gait speed and cadence.

Pilgram et al. (10) performed a gait analysis on the gait platform. The subjects walked on the platform with a black neck brace which extended to their eye level. In this way, the subjects could not see the platform in front of them and their own bodies. As a result, they found that step and stride length decreased significantly. They find no significant change in cadence.

In our results, both step and stride length were found to be the lowest in DC. The highest step and stride length value were found in N. This shows that step and stride length was shortened in all measurements where we changed the visual field. This was

Table 2. Gait analysis data of groups.

	N	LC	RC	DC	UC	P
LSL	59,46 ±6,12	58,76 ±6,24	58,94 ±6,7	57,46 ±6,22	59,06 ±6,42	p < 0,001 (N-DC) p = 0,023 (RC-DC) p < 0,001 (UC-DC)
RSL	60,18 ±5,34	59,94 ±5,32	59,78 ±5,8	58,42 ±5,39	60,12 ±5,55	p = 0,01 (N-DC) p = 0,033 (LC-DC) p = 0,001 (UC-DC)
LST	0,59 ±0,53	0,59 ±0,39	0,59 ±0,46	0,6 ±0,39	0,58 ±0,39	p < 0,001 (UC-DC)
RST	0,59 ±0,45	0,58 ±0,31	0,58 ±0,41	0,59 ±0,39	0,58 ±0,36	p = 0,006 (N-UC) p = 0,018 (LC-DC) p < 0,001 (UC-DC)
LLR	13,57 ±1,74	13,61 ±1,54	14,01 ±2,1	14,05 ±1,64	13,74 ±1,51	p = 0,033 (N-DC)
RLR	13,39 ±1,54	13,56 ±1,69	13,59 ±1,78	13,59 ±1,6	13,45 ±1,57	-
LSS	36,33 ±1,81	36,08 ±1,91	35,31 ±3,69	35,6 ±1,74	36,1 ±1,82	p = 0,01 (N-DC) p = 0,041 (UC-DC)
RSS	36,79 ±1,82	36,52 ±1,69	36,89 ±2,22	36,49 ±1,67	36,59 ±1,65	-
LPS	13,32 ±1,54	13,6 ±1,66	14,07 ±3,88	13,62 ±1,56	13,46 ±1,57	-
RPS	13,42 ±1,68	13,58 ±1,54	13,77 ±1,61	13,97 ±1,64	13,6 ±1,52	p = 0,005 (N-DC) p = 0,029 (UC-DC)
LS	36,67 ±1,8	36,6 ±1,72	36,38 ±3,13	36,56 ±1,64	36,61 ±1,6	-
RS	35,93 ±1,84	35,91 ±1,92	35,12 ±3,62	35,5 ±3,64	35,77 ±1,77	-
TDS	26,88 ±3,08	27,22 ±3,04	27,48 ±3,18	27,69 ±3	27,18 ±2,87	p = 0,048 (N-DC)
SL	119,48±10,93	118,4 ±11,06	118,5 ±12,11	115,8 ±10,99	119 ±11,37	p = 0,001 (N-DC) p = 0,031 (RC-DC) p < 0,001 (UC-DC)
ST	1,2 ±0,09	1,18 ±0,06	1,19 ±0,07	1,2 ±0,07	1,17 ±0,07	p = 0,044 (N-UC) p = 0,001 (LC-DC) p = 0,022 (RC-DC) p < 0,001 (UC-DC)
Cad	50,3 ±3,51	50,9 ±2,85	50,84 ±3,29	49,96 ±3,14	51,3 ±2,96	p = 0,024 (N-UC) p = 0,001 (LC-DC) p = 0,029 (RC-DC) p < 0,001 (UC-DC)
Velo	3,6 ±0,46	3,61 ±0,39	3,6 ±0,43	3,47 ±0,41	3,65 ±0,43	p = 0,011 (N-DC) p = 0,001 (LC-DC) p = 0,002 (RC-DC) p < 0,001 (UC-DC)

N: Normal, LC: Left closed, RC: Right closed, DC: Down closed, UC: Up closed, LSL: Left step length (cm), RSL: Right step length (cm), LST: Left step time (sec), RST: Right step time (sec), LLR: Left load response (%), RLR: Right load response (%), LSS: Left single support (%), RSS: Right single support (%), LPS: Left pre-swing (%), RPS: Right pre-swing (%), LS: Left swing (%), RS: Right swing (%), TDS: Total double support (%), SL: Stride length (cm), ST: Stride time (sec), Cad: Cadence (step/min), Velo: Velocity (km/hr).

Table 3. Data for 30 second static balance measurements.

	N	LC	RC	DC	UC	P
Lomia	6,07 ±2,55	7,03 ±3,39	7,15 ±2,73	6,56 ±3,01	6,82 ±2,96	-
Lomaa	12,68 ±4,34	15,27 ±9,51	16,27 ±9,85	14,17 ±7,29	15,34 ±8,22	-
Area	64,14 ±41,93	94,06 ±96,49	101,1 ±85,27	84,26 ±85,15	92,07 ±92,23	-
COP	241,9 ±49,21	278,3 ±62,69	287,5 ±76,17	271,29 ±70,62	278,0 ±98,74	p = 0,011 (N-DC) p = 0,001 (N-UC) p < 0,001 (N-LC) p < 0,001 (N-RC)

N: Normal, LC: Left closed, RC: Right closed, DC: Down closed, UC: Up closed, Lomia: Length of minor axis (mm), Lomaa: Length of major axis (mm), Area: %95 confidence elipse area (mm²), COP: Center of pressure path length (mm).

Table 4. Data for 60 second static balance measurements.

	N	LC	RC	DC	UC	P
Lomia	6,74±2,62	7,97±4	8,54±3,72	7,85±4,02	8,11±3,84	p = 0,015 (N-UC) p <0,001 (N-RC) p = 0,015 (DC-RC) p = 0,032 (RC-LC)
Lomaa	14,89±5,31	16,72±6,1	17,07±6,46	16,51±7,94	17,01±6,76	-
Area	84,7±59,75	114,12±86,68	127,58±105,43	120,54±141,68	120,42±106,96	p = 0,019 (N-LC) p = 0,004 (N-RC)
COP	489,58±100,38	554,74±142,04	560,19±148,25	548,14±206,2	555,21±156,81	p < 0,043 (N-DC) p = 0,001 (N-UC) p < 0,001 (N-LC) p < 0,001 (N-RC)

N: Normal, LC: Left closed, RC: Right closed, DC: Down closed, UC: Up closed, Lomia: Length of minor axis (mm), Lomaa: Length of major axis (mm), Area: %95 confidence elipse area (mm²), COP: Center of pressure path length (mm).

Table 5. P values regarding to comparison between 30 and 60 second balance analysis.

	N	LC	RC	DC	UC
Lomia	0,044	0,017	0,007	0,003	0,002
Lomaa	0,004	0,026	0,022	0,017	0,038
Area	0,011	0,023	0,016	0,001	0,003
COP	<0,001	<0,001	<0,001	<0,001	<0,001

N: Normal, LC: Left closed, RC: Right closed, DC: Down closed, UC: Up closed, Lomia: Length of minor axis (mm), Lomaa: Length of major axis (mm), Area: %95 confidence elipse area (mm²), COP: Center of pressure path length (mm).

most significantly seen as DC. This result is compatible with the studies in the literature (9,10).

Mullie et al. (11) examined the proprioceptive role of gait in 21 volunteers (12 healthy and 9 hemiparesis individuals). As a result, they did not observe a change in step length and time in both dominant and non-dominant legs. In our study, when we close the left side of the trial frame, we prevent or decrease the right hemisphere's access to proprioceptive information from vision. As similar, when we close the right side, we prevent or decrease the left hemisphere's access. When we affect the right hemisphere, we found out that left step length has decreased, and when we affect the left hemisphere, right step length has decreased. This suggests that the proprioceptive power of vision reaching the hemispheres is effective in gait. Unlike Mullie et al. (11), we think that we may have found this difference because we are blocking visual information.

In our study, cadence was measured at the lowest as DC and the highest as UC. Therefore, the most difference was between DC-UC. Cadence defines the number of steps taken, tempo, for one minute. In contrast to Pilgram et al. (10), our study showed changes in cadence when the person did not see the platform and their body. Also measuring the highest cadence in UC indicates that the tempo has increased. We suggest that the subjects focus more on the platform when they are at UC state, because the lower peripheral visual field is more activated.

Graci et al. (12) reported that peripheral vision is very important in terms of recognizing and evaluating the environment, and many parameters such as step length and velocity are affected by peripheral vision in gait analysis. If we divide the peripheral field into two parts as upper and lower, Marigold and Patla (13) said that the lower peripheral visual field is very important in daily life.

Step and stride time were found to be higher in N and DC significantly. The most significant comparison was between DC-UC. There was also a significant difference between LC-DC in step time on the right lower limb.

The step time increased with DC state. Since the step time increased, we expected swing and pre-swing phase to be increased as well. There was no increase in the swing phase, but an increase in pre-swing phase was observed on the right lower limb in DC state. This indicates that the subject spends more time on the ground in DC state.

In the UC state, our study showed the opposite result. In UC state, step time, stride time and pre-swing phase were found to be the lowest. This means that the subject had less contact with the ground. From this result, we can say that when the subject does not see the platform (DC state), pre-swing phase is increased and therefore increases the step time; and when the subject focuses more on the platform (UC state), pre-swing phase is decreased and thus decreases the step time.

The load response increased on the left lower limb compared to N. Single support phase decreased in DC state on the left lower limb. This decrease was the most significant between N-DC. Total double support was found higher in DC state.

Both feet are in contact with the ground during the load response and the total double support. The fact that these two phases are high in DC means that the time the feet contact the ground increases. The single support is the phase where one foot is in contact with the ground and the opposite foot is in the swing phase. The fact this is low in DC indicates that the subject spends less time on one foot in DC state. The load response and single support phases were also found significant only on the left lower limb in DC state. This indicates that the person is especially affected by these two parameters on the left side. This made us think of hemisphere dominance. %90 of the subjects who participated in our study were left hemisphere dominant. We think people give more weight to the dominant hemisphere side, that is, to the right side in DC state. Further clarification of the role of hemispheres role in gait in the literature will support this idea.

There are many studies supporting the decrease in the velocity of subjects with visual impairment (9, 14, 18-21). In our study, the velocity was seen to be decreased in DC. The highest velocity was observed in UC. The reason for the decrease in velocity in DC may be due to the subject not seeing the platform. The reason we found velocity increased in UC can be because the subject focuses on the platform and the lower peripheral visual field is more active. The views of Marigold and Patra about the lower peripheral visual field support the results we found regarding the velocity. Our study is also correlated with other studies on velocity in the literature (9, 14, 18-21).

The COP was seen highest as RC and the lowest as N in the 30 and 60 second balance measurements. In addition, it was seen that COP increased significantly in all measurements compared to N.

In our study, we prevented or considerably decreased the left hemisphere obtaining visual information while in RC state. The fact that COP is most affected in RC means that COP is more displaced. Which means, COP is more variable in RC.

Pérennou et al. (22) suggested that with patients with stroke, balance disruptions are related to which hemisphere the lesion is located in the brain. Bohannon et al. (23) found that lesions located in the right hemisphere have especially impaired balance. Laufer at al. (24) reported that the improvement after stroke was %60 in patients holding the left hemisphere and %37 in patients holding the right hemisphere. Bonan et al. and Manor et al. (25,26) found that stroke patients holding the right hemisphere are more dependent on visual information to keep balance.

Our study does not comply with the studies presented on the dependence of the right hemisphere on visual information (15, 22-29). On the contrary, our results showed the most significant difference in RC state, that is, when the left hemisphere was impaired. It is noteworthy that the vast majority of the studies presented in the literature are on chronic diseases. Contrary to studies in chronic stroke cases, we created a short-term and acute visual impairment. Despite this, we found a significant difference in RC state. When we prevent or considerably reduce the proprioceptive power of visual information, even in an acute condition, we have seen the balance is affected even though the subject compensates it with somatosensory and non-visual proprioceptive senses. Although this effect was mostly seen in the right hemisphere in the literature, it was found in the left hemisphere in our study. We think the reason for this might be hemisphere dominance.

When the 30 and 60 second measurements were compared, the parameters of length of minor axis, length of major axis, %95 confidence elipse area and COP increased in 60 second balance measurements in all comparisons.

Le Clair et al. (16) compared balance measurement times with the force platform. They measured the subjects with their eyes open and closed both in the normal standing position and Romberg stance. They repeated these measurements at 10, 20, 30, 45 and 60 seconds each. As a result, they obtained significant differences between vision and balance.

Le Clair et al. (16) stated that as the duration of the balance test increases, the oscillations of the subjects increase on the platform and accordingly there is more change COP. They therefore reported that prolonged measurement may be less reliable. They also found that balance was more affected during short test times (10 sec) with eyes closed. They suggested that, as the reason of this, the subjects adapted to the lack of vision as the test duration was extended. They said that the balance analysis lasting 10 seconds is an insufficient time to demonstrate this adaptation and is therefore the least reliable. They suggested that the most reliable balance measurement time was 20 and 30 seconds.

When we compare the 30 and 60 second balance measurements, our study is compatible with the literature (16,17). The significant increase in length of minor and major axis in the 60-second balance analysis indicates that the COP changed in more medial-lateral and anterior-posterior directions within 60 seconds. In addition, the fact that the length of minor axis parameter was only significant in the 60-second balance test emphasizes that as the test period increases, the medial-lateral oscillations increase as well.

In our study, %95 confidence elipse area and COP were found to be quite high in 60 seconds analysis compared to 30 seconds. These two parameters show that the displacement of the COP is greater in 60-second measurements. In this way, we see that the balance is more affected in 60 seconds measurements. This disruption also occurred most in DC state. This shows that if the subject does not see the platform and body, the COP displacement is greater than the other measurements as the balance test time is extended.

Conclusion

In the literature, studies on patients with chronic stroke say that the right hemisphere is more active in balance control. However, contrary to the studies in the literature, we found that when we restrict the visual information, the dominant hemisphere is more affected on balance in healthy subjects. The decrease in step length on the right lower limb in LC state and on the left lower limb in RC state suggests the role of the hemispheres in vision. The change in the load response and the single support phase on the left lower limb, and the pre-swing phase on the right lower limb suggests that the dominant hemisphere may have a role in gait. The parameters affected in DC state in gait emphasize the importance of the lower peripheral visual field. When we compare the 30 and 60 seconds measurements, the results we obtained show that the subject has difficulty in controlling the balance as the time gets longer. We think that our measurements about the effect of proprioceptive power of vision on gait and balance will contribute to the literature in studies related to hemisphere dominance.

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Informed consent: Our study was carried out with the participation of 50 male volunteers between the ages of 18-25. Volunteers who have any diseases that can effect vision, balance and gait were excluded.

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