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Research Article

A Morphometric Examination of The Orbita Structure in Schizophrenia Patients: A Retrospective Study

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Abstract

Aim: To compare the orbita anthropometric measurement values of individuals diagnosed with schizophrenia with those of a healthy control group.
Material and Method: The study included 156 participants as 75 schizophrenia patients and 81 healthy control subjects, all with previous cranial computed tomography imaging. The orbita morphometric values were calculated of all the participants. Statistical comparisons were made between the groups of the mean values of the measurements. The Kolmogorov-Smirnov test was used to evaluate the conformity of continuous variables to normal distribution. Paired groups were compared with the Student's t-test.
Results: Statistically significantly higher left orbita height was determined in the schizophrenia patient group compared to the control group ($p=0.001$), and the values of the right orbita lateral wall length ($p=0.042$), left lateral wall length ($p=0.033$), and left medial wall length ($p=0.014$) were statisically significantly lower. Female schizophrenia patients were found to have significantly lower values of right orbita height ($p=0.031$), right orbita width ($p=0.022$), left orbita height ($p=0.007$), left orbita width ($p=0.002$), right orbita area ($p<0.001$), left orbita area ($p=0.023$), bimalar width ($p<0.001$), left optic nerve-sheath width ($p=0.021$), and skull transverse diameter ($p<0.001$) compared to males. There was determined to be a significant positive correlation between age and the right orbita width and the interorbital width measurements ($p=0.011$, $r=0.203$; $p=0.015$, $r=0.194$, respectively).
Conclusion: These findings can be considered useful in respect of better undertanding the orbita structure of schizophrenia patients.

Keywords: Schizophrenia, orbita, morphometry, multislice computed tomography

INTRODUCTION

Schizophrenia is a chronic mental health disease that generally starts at a young age and disrupts the functionality of the individual with clinical symptoms seen such as problems in thoughts and perception, cognitive disorders, unwillingness and lack of interest, and motor abnormalities (1). Although neurodevelopmental, environmental, and genetic factors are among the causes, the disease etiology remains unclear (2). The importance of the role of genetic factorsin the pathogenesis of schizophrenia has been shown in recent research (3). It has also been reported that environmental factors and some structural changes in the brain caused by genes starting from the intrauterine period can cause the emergence of psychotic symptoms in later periods (4,5). It has been hypothesised that individuals with mental health disease have common phenotypical characteristics of the brain and facial structure exposed to similar effects in the embryological process (6). According to the neurodevelopmental model, developmental changes in the early period are caused by neuron dysfunctions which can explain the signs and symptoms in the premorbid stage of individuals who later develop schizophrenia (7). Anatomic measurements of the facial diameters suggest that dysmorphology concentrated in the craniofacial region orginates from neurodevelopmental disorders in schizophrenia patients (8,9). Although physical abnormalities are of limited value in explaining the disease-specific pathophysiology, certain anomalies in the craniofacial morphology could be informative about schizophrenia (10). It has been said that changes such as low ears and epicanthal eye folds in schizophrenia patients are due to anomalies in the first trimester (11).

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The development of the bulbus oculi, which is an important space located adjacent to various regions including formations related to sight and the brain, starts in the third week of intrauterine life, as it also does in the brain and face with typical devlopment (12). As the eyeball and orbita structure are most likely related to fetal anthropometric growth (13), the anatomy of these structures may be important in terms of neurodevelopmental diseases because of fetal growth abnormalities. From a scan of the literature, it was seen that previous morphometric studies of schizophrenia patients have been conducted (14,15). For example, it has been reported from anthropometric analyses that there is a development disorder in the mid section of the skull in schizophrenia patients (16). However, no study could be found that has evaluated the orbita structure of these patients. Therefore, the aim of this study was to evaluate the anthropometric measurements of the orbita structure in schizophrenia patients through comparisons of the measurements made on multi-slice computed tomography with those of a healthy control group.

MATERIAL AND METHOD

This study was approved by the Non-Interventional Research Ethics Committee of Fırat University (Decision no: 21853, Date: 02.02.2024). The medical records of individuals who attended the Fethi Sekin City Hospital from January 2020 to January 2024 were reviewed using the hospital registration system. Previous treatment and comorbidities of the patients were analyzed according to the data in the patient record system. The study included patients who presented within the defined date range. A retrospective evaluation was made of the images archived in the hospital Picture Archiving and Communication System (PACS). All the computed tomography (CT) scans were performed using a 128-slice CT scanner (Ingenuity Core 128; Philips Medical Systems, Best, the Netherlands). Non-contrast axial and coronal images were obtained at slice thickness of 0.5mm. The medical history, anamnesis and other systemic diseases of the patients were examined in detail from the hospital record system by a mental health and diseases specialist. The healthy control group comprised demographically matched individuals who had undergone a routine annual check-up at the hospital and had no known systemic or mental illness.

Exclusion criteria for the study were defined as age <18 years, poor quality CT scans, pathology determined in the orbital structures, or the presence of orbita fracture, tumour, or foreign body in this region. A total of 22 subjects were excluded; 15 schizophrenia patients and 7 healthy individuals with incomplete data. Thus, a total of 156 participants were included in the study analyses; 75 schizophrenia patients and a control group of 81 healthy individuals.

Orbita height was measured on coronal slices as the longest vertical distance between the midpoints of the supraorbital and infraorbital edges (Figure 1A) (17).

Orbita width was measured on coronal slices as the longest horizontal distance between the medial and lateral edges of the orbita at the surface level of the frontozygomatic suture (Figure 1A) (17).

Orbita depth: first the level of the optic nerve continuously observed on axial slices was determined. A line was drawn joining the lateral and medial walls of the trajectory. With another line descending vertically from the previous line to the midpoint of the optic canal, the orbita depth was determined (Figure 1B) (18).

Orbita medial and lateral wall lengths were measured on axial slices at the level continuously followed by the optic nerve and where the fissura orbitalis was seen. The medial wall length was measured as the distance between the anterior corner of this wall and the anteromedial point of the optic canal. The lateral wall length was measured as the distance between the anterior corner of this wall and the anterolateral edge of the fissura orbitalis superior (Figures 1C, D) (19).

Orbital aperture area was calculated bilaterally by following certain anatomic points on the orbita edges on coronal slices using the software of the hospital imaging system. These anatomic landmarks were the foramen supraorbitale, anterior edge of the fossa lacrimalis, frontozygomatic suture, and infraorbital edges. The area of the covered bone line drawn was calculated automatically by the software (Figure 1E) (20).

Bimalar (interzygomatic) width was measured as the distance between the most prominent anterior points of the right and left zygomatic bones (Figure 1F) (21).

Biorbital width was measured as the distance between the most prominent lateral points of the right and left orbita (Figure 1G) (21).

Interorbital width was measured as the distance between the two dacryon points at the medial edges of the orbital apertures (Figure 1H) (21).

Optic nerve-sheath width was measured on the axial slice where the optic nerve was widest and width was measured from the place where the optic nerve and sheath seemed to be the thickest (Figure 1I) (22).

Skull transverse diameter measurement was the distance between the furthest points of the skull transverse diameter on the axial slice where the transverse diameter was greatest (Figure 1J) (23).

The measurements were taken twice by the same expert and the average was calculated.

Statistical Analysis

Statistical analyses of the study data were performed using SPSS vn. 22 software (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL, USA). Descriptive statistics were stated as mean±standard deviation (SD) values for continuous variables and as number (n) and percentage (%) for categorical variables. Pearson chi-square analysis was applied in the comparisons of categorical variables between groups. The Kolmogorov-Smirnov test was used to evaluate the conformity of continuous variables to normal distribution. Paired groups were compared with the Student's t-test. To examine the relationships between continuous variables, Pearson correlation analysis was applied. Statistical significance was accepted as $p<0.05$.

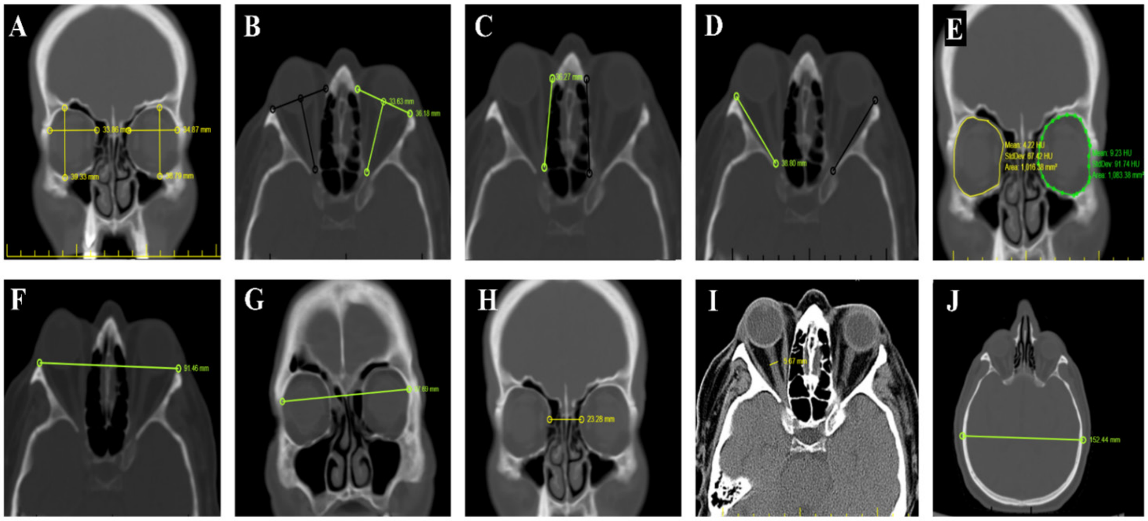

Figure 1. Morphometric evaluation of the orbita

RESULTS

Evaluation was made of a total of 156 participants, as 75 schizophrenia patients and 81 healthy control subjects. The patient group comprised males (65.3%) and females (34.7%) with a mean age of 53.7±16.4 years. The control group comprised males (63%) and females (37%) with a mean age of 53.1±16.4 years. There was no significant difference between the groups in terms of gender or age (p=0.758, p=0.810, respectively).

The height of the left orbita was determined to be statistically significantly higher in the schizophrenia patient group than in the control group (p=0.001), and the values of the right orbita lateral wall length (p=0.042), left orbita lateral wall length (p=0.033), and left orbita medial wall length (p=0.014) were significantly lower (Table 1).

Table 1. Comparisons of the demographic characteristics and tomographic measurements of the groups

		Patients (n=75)		Control (n=81)		p*
		n	%	n	%	
Gender	Female	26	34.7	30	37.0	0.758
	Male	49	65.3	51	63.0	
		Mean±SD		Mean±SD		p**
Age (years)		53.7±16.4 (19-70)		53.1±16.4 (21-68)		0.810
Right A		34.5±2.3		34.3±1.8		0.640
Right B		39.9±6.7		39.0±2.5		0.267
Right C		37.8±3.0		38.1±2.8		0.494
Left A		34.8±2.0		33.7±2.0		0.001
Left B		39.5±4.1		39.1±2.4		0.486
Left C		37.6±3.7		38.3±2.7		0.169
Right lateral		40.9±2.9		41.8±2.8		0.042
Right medial		41.4±3.8		42.5±3.9		0.066
Left lateral		40.4±3.2		41.5±3.0		0.033
Left medial		41.1±5.3		42.7±2.9		0.014
Right area		1086.7±99.3		1073.3±87.1		0.369
Left area		1073.5±135.1		1048.4±82.5		0.160
Bimalar		97.3±4.2		96.5±4.9		0.266
Biorbital		94.6±4.1		92.0±11.6		0.066
Interorbital		25.5±3.0		26.6±11.4		0.411
Right optic nerve		5.4±.7		5.3±.7		0.408
Left optic nerve		5.2±.8		5.3±.7		0.898
Tranverse diameter		140.3±8.7		139.0±6.5		0.289

*Chi-square analysis, **Student's t-test

In the female patients diagnosed with schizophrenia, the values of the right orbita height (p=0.031), right orbita width (p=0.022), left orbita height (p=0.007), left orbita width (p=0.002), right orbita area (p<0.001), left orbita area (p=0.023), bimalar width (p<0.001), left optic nerve-sheath width (p=0.021), and skull transverse diameter (p<0.001) were determined to be statistically significantly lower than those of male schizophrenia patients (Table 2).

A significant positive correlation was determined between age and the right orbita width and the interorbital width measurements (p=0.011, r=0.203; p=0.015, r=0.194, respectively) (Table 2).

Table 2. Relationships between the demographic characteristics and tomographic measurements

	Female (n=56)	Male (n=100)	p*	Age	
	Mean±SD	Mean±SD		r	p**
Right A	33.9±2.0	34.6±2.1	0.031	0.083	0.300
Right B	38.2±2.6	40.1±5.8	0.022	0.203	0.011
Right C	37.9±3.1	38.0±2.8	0.906	0.084	0.299
Left A	33.6±1.8	34.6±2.1	0.007	-0.025	0.757
Left B	38.2±1.9	39.9±3.8	0.002	0.027	0.735
Left C	37.4±3.3	38.3±3.2	0.090	0.054	0.502
Right lateral	41.1±2.8	41.5±2.9	0.381	0.038	0.638
Right medial	41.9±3.8	42.0±3.9	0.888	0.012	0.885
Left lateral	40.5±2.9	41.2±3.2	0.157	-0.009	0.914
Left medial	41.4±3.7	42.3±4.6	0.227	-0.014	0.859
Right area	1044.3±95.1	1099.6±86.2	<0.001	0.108	0.181
Left area	1033.5±76.4	1075.6±124.5	0.023	0.110	0.171
Bimalar	95.0±5.5	98.0±3.6	<0.001	0.055	0.492
Biorbital	91.5±9.8	94.3±8.2	0.056	-0.052	0.522
Interorbital	26.0±9.6	26.1±7.8	0.913	0.194	0.015
Right optic nerve	5.3±.6	5.5±.7	0.105	0.133	0.098
Left optic nerve	5.1±.7	5.4±.7	0.021	0.082	0.310
Tranverse diameter	136.2±6.7	141.5±7.5	<0.001	0.005	0.952

* Student's t-test, ** Pearson correlation analysis

DISCUSSION

Anthropometric measurements performed appropriate to certain standards provide a great amount of data about the human body anatomy. These measurements are taken in the framework of certain protocols and measurement techniques which are generally accepted worldwide. In addition to measurements taken with manual calipers, they can now be taken with imaging methods due to developments in technology. In this study, which aimed to compare the anthropometric measurements of the orbital structure in schizophrenia patients with measurements made on multi-slice CT and in the healthy control group, showed that the left and right orbital lateral edges and the left orbital medial wall were shorter in schizophrenia patients. The orbita structures of female schizophrenia patients were seen to be smaller than those of the male schizophrenia patients. It can also be said that the orbita measurements of schizophrenia patients show variability with age.

In terms of neurodevelopmental diseases, it has been reported that there are various physical malformations in patients with schizophrenia, especially in the craniofacial region (24). During the intrauterine period, the craniofacial region and the ventral section of the brain develop at similar times, so a disruption in the stage of formation of one renders the other structure prone to malformation (25,26). The anatomic or embryonic interaction between the face and the brain can also affect brain functions (27). The first psychotic attack of schizophrenia patients usually occurs in late adolescence or early adulthood, and when the preceding period has been examined, there have been observed to be small physical cranio-cerebral (ears, palate, head circumference), some oral anomalies (teeth measurements), temporomandibular, and palatal abnormalities (28). It has been reported that these patients have an increased frequency of abnormal head circumference, hypertelorism, conjoined earlobes, thick palate, epicanthus and finger anomalies (24). Orbita morphometry can be used for the early determination of some diseases (29). Technological methods have also been used recently to provide reliable reference values for clinicians and to facilitate the identification of normal and abnormal orbita anatomy (30). In a previous study of healthy individuals in Türkiye, the orbita height width and depth mean values were calculated to be 36.04±2.97 mm,

32.33±2.59 mm, and 38.35±3.32 mm, respectively on the right side and 35.79±3.18 mm, 32.29±2.67 mm, and 38.13±3.21 mm, respectively, on the left side (31).

A study in Iran examined orbita morphometry using 3-dimensional CT (3DCT) and the measurements were reported for the right and left sides as mean orbital height of 3.75±0.20 cm and 3.74±0.21 cm respectively, orbital width of 3.44 cm±0.17 cm and 3.46 cm±0.17 cm, and interorbital-biorbital width of 2.26 cm±0.26 cm and 9.55±0.41 cm. Orbital volume on both the left and right sides was found to be significantly greater in males compared to females, and a significant correlation was determined between age and the right and left orbital volume (32). The anthropometric examinations of the orbita of the current study schizophrenia patients were performed using multi-slice CT. It was observed that the right and left orbita lateral edges and the medial wall of the left orbita were shorter in the patients than in the healthy control subjects. These findings are promising in respect of being able to identify groups at risk of schizophrenia with imaging methods of the orbita morphometry, especially the left side, before disease symptoms emerge, and to therefore be able to make the early interventions required by these groups. From a scan of the literature, this study can be considered the first to have evaluated orbita morphometry in schizophrenia, which is important for early diagnosis and treatment.

The current study results revealed a difference in orbita structures between the genders, with the orbita anthropometric measurement values of females observed to be smaller than those of males. In addition, it was seen that the orbita measurements of schizophrenia patients showed variability with age. It has been previously reported that morphometric measurements can show differences due to age and gender (33,34). Erdem et al. reported that with the exception of vertical diameter, all the orbita measurement values were significantly greater in males than in females (30). In diseases such as Graves disease, there are also known to be changes in orbita lipid volume together with ageing (35). Although similar to the age of the control group, the higher mean age of the current study patients could have affected the orbita measurement values. Therefore, as the results could affect the evaluation of orbita anthropometry, there is a need for further studies of younger schizophrenia patients.

Limitations of this study can be said to be the single-centre, retrospective, cross-sectional design, the relatively small sample size, and that the severity of disease symptoms was not known.

CONCLUSION

In conclusion, as in all diseases, early diagnosis and treatment of mental health diseases is important in respect of morbidity and mortality. Based on the findings of the current study, the aim of which was to detect the disease in the prodromal period, the determination of reference measurement values of the orbita using advanced technology methods in a larger sample group could facilitate the early detection of mental health diseases by clinicians. Therefore, the findings of this study can be considered of guidance for further studies to be conducted in this field.

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Conflict of interest: *The authors have no conflicts of interest to declare.*

Ethical approval: *This study was approved by the Non-Interventional Research Ethics Committee of Fırat University (Decision no: 21853, Date: 02.02.2024).*

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