

**ORIGINAL RESEARCH**

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**Analysis of the dermatoglyphics of patients with obstructive sleep apnea****Mustafa Canbolat<sup>1</sup>, Hilal Ermis<sup>2</sup>, Furkan Cevirgen<sup>1</sup>, Deniz Senol<sup>1</sup>, Turgay Karatas<sup>3</sup>, Evren Kose<sup>1</sup>, Davut Ozbag<sup>1</sup>**<sup>1</sup>Inonu University, Faculty of Medicine, Department of Anatomy, Malatya, Turkey<sup>2</sup>Inonu University, Faculty of Medicine, Department of Chest Diseases, Malatya, Turkey<sup>3</sup>Malatya Training and Research Hospital, Department of General Surgery, Malatya, Turkey

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**Abstract**

Dermatoglyphics outside the normal distribution may be signal of hereditary anomaly in prenatal period. Obstructive sleep apnea syndrome (OSAS) is defined as the suspension of breathing for 10 seconds or more. Genetic predisposition can be suggested in the OSAS. The aim of this study is to assess through dermatoglyphics whether genetic factors are effective in OSAS because skin glyphs and pharyngeal are originate from ectoderm. Our study was conducted with 134 volunteers, 68 (21 females, 47 males) individuals with OSAS and 66 (21 females, 48 males) healthy individuals. The photographs of the palms and fingertips of the right and left hands of the participants were taken with high definition cameras. These images were enlarged with computer and their dermatoglyphics were assessed. Fingertip loop types, total number of fingertip lines, total a-b line numbers and atd angles were assessed in healthy individuals and patients with OSAS. We found a statistically significant difference between the right and left hand atd values of healthy individuals and individuals with OSA. atd values can be used as an early indicator of OSAS.

**Keywords:** Dermatoglyphics, Obstructive sleep apnea, Genetic**Introduction**

Dermatoglyphics, formed from a combination of Latin derma (skin) and glyph (cavity), are special patterns formed by the epidermal ridges on finger tips, the palms and soles [1]. Dermatoglyphics appear between the prenatal 10th and 18th weeks and their formation is completed on the 19th week [2]. Dermatoglyphics do not change according to age or environmental effects and patterns differ from person to person [1,3,4].

Dermatoglyphics outside the normal distribution signal a hereditary anomaly in prenatal period [5]. The genes effective in the formation of dermatoglyphics are polygenic [4]. Since the anomalies about the number and structure of chromosomes cause changes in dermatoglyphics, these epidermal patterns on fingers, palms and soles can be used as auxiliaries in the diagnosis of diseases [6,7]. Apnea, which means "apnoia" in Greek is defined as the suspension of breathing for 10 seconds or more [8]. Recurrent suspension of breathing during sleep due to apnea results in decreases in oxygen saturation, interrupted sleep, being sleepy and tired during the day [9]. Sleep apnea is a serious disease which

influences a great number of body systems and creates a risk factor for diseases such as hypertension, ischemic heart disease, diabetes, obesity and cerebrovascular diseases [10,11]. This disease, which greatly affects a person's quality of life, was defined in 1970s for the first time and it was accepted as a social health problem in 1990s. Accidents such as Chernobyl and Exxon Valdez have been found to result from disease related cognitive disorders and day time somnolence [12]. There are three types of apnea as obstructive, central and mixed.

Obstructive sleep apnea syndrome (OSAS) is the obstruction of mouth and nose respiration despite an effort for respiration, central apnea is the absence of both respiratory effort and airflow, and mixed type apnea starts with central apnea and continues despite an effort for respiration [12]. Although there have been developments about the disease, there are still difficulties in the diagnosis and treatment [13]. Early diagnosis of this disease is important for the prevention of life threatening situations such as hypertension, cardiovascular diseases, cerebrovascular disease and traffic accidents [14]. In this disease, the physiopathology of which includes a great number of factors, the primary reason of the disease is the constriction or obstruction of the pharyngeal airway. Under normal conditions, pharyngeal airway does not constrict with pressure from the outside due to its anatomical position. However, with the co-occurrence of some factors, although there

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is no pressure coming from the outside, airway can be obstructed during sleep [15]. In apnea, there is a disproportion between soft tissue and bone skeleton boundary. Thus, the canal constricts when the soft tissues in the airway cover too much of a place and/or due to the narrowness of the bone skeleton [16]. In apnea patients, deviations from healthy population such as small pharynx diameter [17], smaller and anteriorly located mandibula and maxilla [18, 19], inferiorly located hyoid bone [20], lateral pharyngeal wall thickness, increase in the tongue and total soft tissue volume [21] show that genetic predisposition can be discussed in the disease.

Deviations from the normal in the anatomical structure of the pharyngeal area are one of the main situations which are thought to have an influence on sleep apnea syndrome. Ectoderm neural crest cells form the structure of the middle of the face and the skeletal structure of pharyngeal arcus and all other tissues in this area, including cartilage, bone, tooth, tendon, skin, meninx, sensory neurons and gland stroma. Similarly, our skins and extensions are also ectodermic [22]. Thus, a change that can occur embryologically will result in these two structures being influenced together.

Our purpose in this study is to assess through dermatoglyphics whether genetic factors are effective in obstructive sleep apnea syndrome.

## Material and Methods

2017/30 protocol numbered ethical board approval was taken from İnönü İnönü University, Faculty of Medicine. Clinical Researches Ethical Board for our study.

All our volunteers read and signed the informed consent form.

Our healthy volunteers were chosen among individuals who did not have obstructive apnea syndrome, those who did not have anyone diagnosed with obstructive apnea syndrome in the family, and those who did not have any diseases or suspicions of any diseases which had genetic transition such as diabetes mellitus, cardiovascular disease, hypertension, systemic disease, birth anomaly, based on the self-reports of this group. We were also careful that these individuals did not have any deformities that could prevent us from seeing the dermatoglyphics on their palms or finger tips. Our patient group consisted of individuals who were referred to İnönü University Faculty of Medicine, Sleep Polyclinic and who were diagnosed with "Obstructive Sleep Apnea Syndrome" with an apnea-hypopnea index (AHI) of 15 and over as a result of polysomnographic examinations.

All finger tips and palms on the right and left hands of both the healthy group and the patient group were photographed with high definition camera (NIKON D3200). These images were transferred to computer. The measurements were made on these images by using Digimizer Version 4.6.1 program. Our data were analyzed and classified according to Cummins and Midlo's method [23].

Fingertip ridge number was obtained by counting the fingertip dermal ridges intersecting the straight ridge combining fingertip loop type centre and triradius. In fingertip patterns in the form of loops or double loops, we obtained more than one fingertip ridge.

We considered the largest of these as fingertip ridge number. We considered the number of ridges on a finger on which there were arch type fingertip loop types as zero. By adding up the fingertip ridge numbers of 10 fingers of an individual, we found the total fingertip ridge number of that individual (Figure 1).

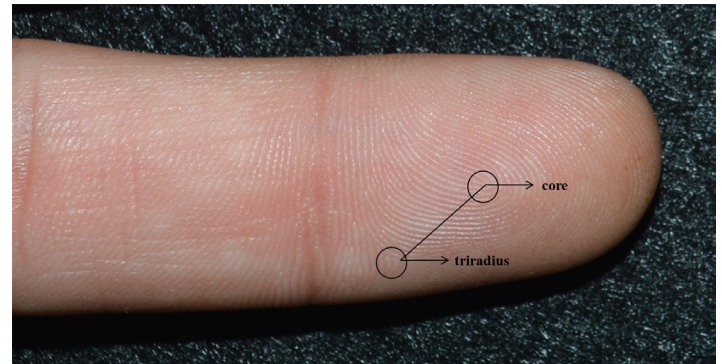


Figure 1. Dermal ridges between triradius, fingertip loop type centre

We found a-b ridge number by counting the dermal ridges intersecting the straight line combining the triradius of index finger (a) and the lower part of the middle finger (b). We found the a-b ridge number separately for each hand. The total number of both gave us the total a-b ridge number (Figure 2).

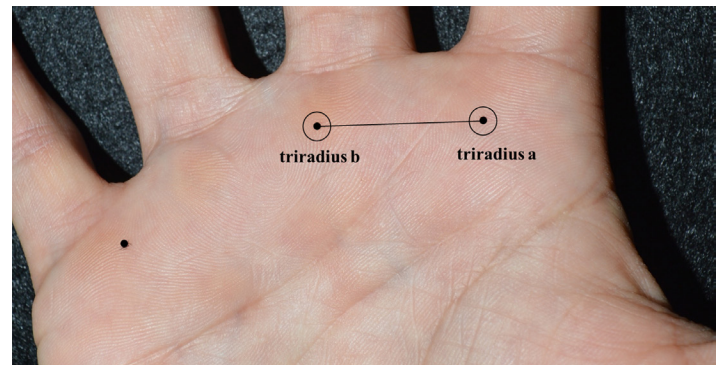


Figure 2. Dermal ridges between triradius a and triradius b

We found the atd angle by calculating the angle between the ridges from the triradius on the sole of the index finger (a) to the axial triradius on the sole of the palm (t) to the triradius on the lower part of the little finger (Figure 3).

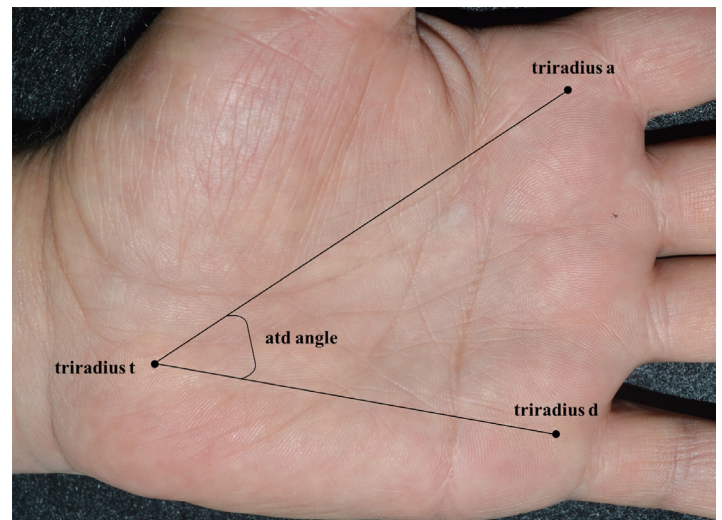


Figure 3. Evaluation of atd angle

### Statistical Analysis

IBM SPSS Statistics 22.0 program was used for statistical analyses. Normality distribution of the data was tested with Shapiro-Wilk test. Since the data were not normally distributed, median, minimum (min) and maximum (max) values were used as descriptive. Mann-Whitney U test was used for statistical analyses.  $p < 0.05$  value was considered as statistically significant.

### Results

Our study was conducted with 134 volunteers, 68 (21 females, 47 males) individuals with OSA and 66 (21 females, 48 males) healthy individuals (Table 1).

We found that the average age of males with OSAS was 50 (27-79), while the average age of females with OSAS was 60 (44-75). We found that the average age of healthy males was 31 (19-54), while the average age of healthy females was 23 (19-59) (Table 2).

In our study, arch, which is a fingertip loop type, was found more in both females and males with OSAS than healthy individuals. However, this difference was not statistically significant. No statistically significant difference was found between the fingertip

loop types of an individual with OSA and healthy volunteers in terms of other fingertip loop types (Table 3).

**Table 1.** Distribution of individuals with OSA and healthy individuals by gender

Groups	Female		Male		Total	
	n	%	n	%	n	%
<b>OSA</b>	21	30.9	47	69.1	68	50.7
<b>Healthy</b>	21	31.9	45	68.1	66	49.3

OSA: Obstructive sleep apnea

**Table 2.** Age distribution of individuals with OSA and healthy individuals

Groups	Female	Male
	Med (Min-Max)	Med (Min-Max)
<b>OSA</b>	60 (44-74)	50 (27-79)
<b>Healthy</b>	23 (19-59)	31 (19-54)

OSA: Obstructive sleep apnea

**Table 3.** The distribution percentage of fingertip loop types of individuals with OSA and healthy individuals

Fingertip loop type	Female			Male		
	OSA (%)	Healthy (%)	p	OSA (%)	Healthy (%)	p
Whorl	29.5	35.8	.253	47.5	43.5	.324
Ulnar loop	55.2	57.6	.647	44.7	50.3	.733
Radial loop	1.4	1.4	.083	1.4	3.1	.891
Arch	13.9	5.2	.351	6.4	3.1	.366

OSA: Obstructive sleep apnea

We found a statistically significant difference between the right and left atd values of males with OSAS and healthy males. We also found a statistically significant difference between the right and left atd values of females with OSAS and healthy females. Independent

of gender, we found a statistically significant difference between the right and left atd values of all healthy individuals and all individuals with OSAS. In our study, we could not find any differences between groups in terms of ab ridge numbers (Table 4, 5).

**Table 4.** Comparison of atd angle and ab ridge count of individuals with OSA and healthy individuals by gender

Parameter		Groups	Male			Female		
			n	Med (Min-Max)	p	n	Med (Min-Max)	p
atd angle	right	OSA	47	42.89° (31.66-51.42)	.007	21	43.97° (36.38-47.34)	.015
	hand	Healthy	45	41.18° (31.38-50.76)		21	41.67° (33.77-44.72)	
	left	OSA	47	43.02° (34.82-52.85)	.008	21	45.15° (36.22-47.04)	.000
	hand	Healthy	45	41° (33.27-46.67)		21	40.14° (34.95-45.32)	
ab ridge count	right	OSA	47	41 (32-60)	.318	21	42 (34-52)	.860
	hand	Healthy	45	42 (32-56)		21	41 (35-50)	
	left	OSA	47	43 (36-54)	.433	21	44 (36-48)	.184
	hand	Healthy	45	42 (33-55)		21	44 (34-52)	

OSA: Obstructive sleep apnea



**Table 5.** Comparison of atd angle and ab ridge count of individuals with OSA and healthy individuals independent from gender

Parameter	Groups	n	Med (Min-Max)	p
atd angle	All OSA	68	43.54 (31.66 - 51.42)	.000
(right hand)	All healthy	66	41.19 (31.38 - 50.76)	
atd angle	All OSA	68	41.15 (34.82 - 52.85)	.000
(left hand)	All healthy	66	40.92 (33.27 - 46.67)	
ab ridge count	All OSA	68	41 (32 - 60)	.437
(right hand)	All healthy	66	42 (32 - 56)	
ab ridge count	All OSA	68	43 (36 - 54)	.855
(left hand)	All healthy	66	43 (33 - 55)	

OSA: Obstructive sleep apnea

No differences were found between groups in terms of total fingertip ridge number and total ab ridge number (Table 6).

**Table 6.** Comparison of total fingertip ridge number and total ab ridge number of individuals with OSA and healthy individuals

Parameter	Groups	Male			Female		
		n	Med (Min-Max)	p	n	Med (Min-Max)	p
Total fingertip	OSA	47	167 (73-237)	.451	21	150 (9-246)	.443
ridge number	Healthy	45	173 (65-286)		21	156 (28-223)	
Total ab ridge	OSA	47	83 (71-114)	.888	21	84 (70-100)	.435
number	Healthy	45	83 (66-111)		21	86(69-100)	

OSA: Obstructive sleep apnea

## Discussion

Our study was built on the hypothesis that the skin glyphs originating from ectoderm and pharyngeal area would be influenced together in case of a genetic influence. In our study, significant difference was found between the atd angles of individuals with OSA and healthy individuals. This difference was found in both right and left hand. In addition, atd angle was found to be different between the patients and the healthy group both when the genders were assessed in their own right and when the assessments were made independent of genders. No statistically significant differences were found between groups in terms of fingertip loop types, ab ridge numbers, total finger ratio ridge numbers and total ab ridge numbers. Due to the variations in OSAS phenotype, it is difficult to research the candidate genes responsible for genetics. Previous regression analyses have also supported that explaining the familial aggregation in OSA is a complex situation consisting of many factors interacting in a complex way and including environmental elements [24]. The results of our study bring to mind that in such a situation, if OSA is found in the family, dermatoglyphics can be useful as a predictive method of the disease in other individuals.

There are studies investigating the associations between diseases thought to be influenced by genetic factors and dermatoglyphics. In a great number of diseases such as leukemia [25], schizophrenia [26] and breast cancer [27], in which genetic factors are thought to have an influence, dermatoglyphics has been studied between genders [28] and ethnic groups [29].

In a study conducted on Hodgkin patients [30], fingertip loop type percentages in healthy males were found as arch (1.2%), loop (37.4%), ulnar loop (55.9%) and radial loop (5.5%); while in healthy females they were found as arch (6.8%), loop (32.9%), ulnar loop (56.1%) and radial loop (4.2%). According to the results of our study, radial loop rate was found very high in both genders-

especially in females. Arch rate was found to be higher in healthy males (3.1%). In our study, ulnar loop had the highest percentage. In studies conducted with Hodgkin patients, total fingertip ridge number was found as  $126.95 \pm 34.68$  in healthy males, while it was found as  $108.53 \pm 42.79$  in healthy females. In our study, total ridge numbers of males were found to be higher than those of females. atd angle was found as  $51.97 \pm 10.21^\circ$  in the right hand and as  $48.64 \pm 10.88^\circ$  in the left hand of healthy males, while it was found as  $52.50 \pm 11.69^\circ$  in the right hand and it was found as  $51.97 \pm 10.21^\circ$  in the left hand. Since our data were not normally distributed, we used median values and no statistically significant differences were found between healthy males and healthy females. Total ab ridge number was found as  $76.07 \pm 11.89$  in healthy males and as  $74.07 \pm 7.28$  in healthy females in studies conducted with Hodgkin patients. We found similar results in our study.

In a study conducted with migraine patients [31], while the arch type was found in the right hands of the control group females with a rate of 9% and in the left hands with a rate of 11%, it was found as 8% in the right hands of men and as 6% in the left hands of men. Arch rate is very high when compared with our results. In this study conducted with migraine patients, atd angles were found to be statistically significant between the patient and the control group. Nervous system is also ectodermic in terms of embryological development. Thus, like in our study, genetic influence causes deviations from the normal in ectodermic structures. ab ridge number and total fingertip ridge numbers are parallel to the results of our study in healthy control group.

In a study conducted with colon ca patients [32], ulnar loop was found as the most frequent loop type like in our study. Arch rate was found as 3.6% in healthy males and as 2.8% in healthy females. While the arch rate was similar to the results of our study in males, the rate was less than 5.2% in females. When ab ridge number, total fingertip ridge number and atd angles were analyzed,

the results were found to be similar to our results.

In previous studies which stated that obstructive sleep apnea syndrome had a genetic component, it was shown that factors associated with OSA such as familial predisposition to obesity, craniofacial problems including short maxilla and mandibula, respiratory control and response during sleep shared a common genetic root [33]. Our study is the first one with dermatoglyphics to support that patients with obstructive apnea syndrome have genetic component. Needless to say, the results obtained from dermatoglyphics are not diagnostic. However, since there are deviations from the normal, it will encourage about further research. For example, in a study conducted on breast cancer [34], a decrease was found in total fingertip ridge numbers. In another study conducted on cancer patients [35], increases were shown in loops in patients and in another study [36], increases were found in ulnar loops in cancer patients.

In conclusions, atd values can be used as an early indicator of OSAS.

#### Competing interests

*The authors declare that they have no competing interest*

#### Financial Disclosure

*The financial support for this study was provided by the investigators themselves.*

#### Ethical approval

*2017/30 protocol numbered ethical board approval was taken from İnönü İnönü University, Faculty of Medicine. Clinical Researches Ethical Board for our study.*

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