

ANALYSIS OF DISTAL TRANSVERSE, PROXIMAL TRANSVERSE AND THENAR CREASE TYPES

Distal transvers, proksimal transvers ve thenar çizgi tiplerinin analizi

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ABSTRACT

Objective: Palmar creases, which develop during embryonic life, are clinically important for identifying potential chromosomal abnormalities. This paper investigated palmar creases' definition, variation, course, type, and class.

Material and Methods: The sample comprised 753 right and left hands of 377 participants (222 females and 155 males). Participants were recruited from the Faculty of Medicine of Karadeniz Technical University. Their palmar creases were visualized and classified according to the type, location, and relationship with each other.

Results: The distal transverse, proximal transverse, and thenar creases were predominantly of the forked type. When comparing the localization types of the proximal transverse and thenar creases on the radial side of the right and left hands by gender, the closed type was found to be the most common in both hands.

Conclusion: This study focused on palmar creases. Our results provide clues for early detection of chromosomal aberrations. We think that we need to define palmar creases as a useful indicator during surgery.

ÖZ

Amaç: Palmar çizgiler, embriyonal hayatta gelişirler. Kromozomal bozuklukların olasılığını tanımlamada palmar çizgiler klinik öneme sahiptir. Bu çalışmada, palmar çizgilerin tanımını, varyasyonlarını, seyrini, tiplerini, birbirleri ile ilişkilerine göre sınıflandırmalarını ve detaylı analizinin araştırılması amaçlanmıştır.

Gereç ve Yöntemler: Çalışmada, Karadeniz Teknik Üniversitesi Tıp Fakültesi öğrencilerinden 222'si kadın, 155'i erkek olmak üzere 377 deneğin sağ ve sol toplam 753 eli değerlendirmeye alındı. Palmar çizgiler, görüntülediği Palmar çizgilerin tiplerine, çizgilerin birbirleri ile ilişkilerine ve yerleşimine göre sınıflandırmalar yapıldı.

Bulgular: Distal transvers, proksimal transvers ve thenar çizgi tiplerinde sıklıkla çatallı tip olduğu bulundu. Sağ ve sol el proksimal transvers ve thenar çizginin radial taraftaki yerleşim tiplerini cinsiyete göre karşılaştırıldığında sağ ve sol elde en sık kapalı tip olduğu görüldü.

Sonuç: Çalışmada palmar çizgilerin varyasyonları, tipleri, yerleşimleri tanımlandı. Bu analizler, klinikde kromozomal sapmalarının erken tespiti için ipuçları vererek yardımcı olabilir. Elin palmar çizgilerini tanımlamak cerrahi girişimler sırasında yararlı bir gösterge olacağı düşünülmektedir.

Keywords: Palmar crease, hand, gender

Anahtar Kelimeler: Palmar çizgi, el, cinsiyet



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INTRODUCTION

Palmar creases are distinct and readily visible flexion lines located on the palm. They develop due to the adhesion of the skin to the deep fascia and become more pronounced in the skin folds during hand movements.^{1,2} Palmar creases are important anatomical landmarks that help us identify the location of structures and their relationships with the underlying deep structures.^{2,3}

The palmar surface contains three major creases: the proximal transverse crease, the distal transverse crease, and the thenar crease. The proximal and distal transverse creases extend transversely.^{2,4} The distal transverse crease originates from the ulnar border of the palm and extends transversely with a slight convexity, passing over the second and fourth metacarpal heads.^{2,3} The proximal transverse crease originates from the radial border of the palm.³ As it extends toward the ulnar side of the hand, it follows a gentle curve proximally from the radial side of the palm.² The thenar crease defines the thenar region and is the deepest line along the border of the thenar eminence, formed by the thumb muscles.^{5,6} It originates from the radial side of the palm and the lateral side of the proximal transverse crease.^{2,3,6} Curving obliquely across the palm, it intersects the distal wrist crease near the center of the wrist. On the palmar surface, it typically merges with the proximal transverse crease near the radial border but may also appear independently.⁶

The most significant variations of palmar creases include the Simian crease, Sydney crease, and Suwon crease.⁷ The Simian crease is a single transverse line that extends across the palm, resulting from the fusion of the proximal and distal transverse creases.^{7,8} The Sydney crease is a variation where the proximal transverse crease extends entirely across the palm.^{7,8} The Suwon crease, a recently identified variant with an incidence of 0.5%, is a single transverse crease extending across the palm. It forms through the fusion of the accessory proximal transverse crease and two transverse creases.^{7,8}

There is a large body of research into the development of palmar creases. They develop under genetic control during the intrauterine period, influenced by hand flexion movements as well as independent factors unrelated to these movements.⁸⁻¹⁰ Palmar creases begin to develop early in fetal life. Inter-finger notches in the hand plate start forming by the 6th week of intrauterine development. By the 9th week, the thenar crease becomes clearly visible. The distal and proximal transverse creases emerge by the 13th week, and by the 15th week, palmar creases are fully formed.⁹

The Simian and Sydney creases are variant palmar creases that are significantly associated with various

chromosomal abnormalities and diseases. These conditions may have a genetic basis or result from environmental influences and exposure to teratogenic agents.¹¹ The Simian crease is commonly observed in individuals with Down syndrome and other chromosomal abnormalities. Both the Simian and Sydney creases are linked to various clinical syndromes, including Down syndrome, Turner syndrome, trisomy 18, trisomy 13, cri-du-chat syndrome, and certain psychological disorders.^{6-8,12-14} Palmar creases provide valuable clues for clinical evaluation. If we identify them during clinical examinations, we can detect chromosomal anomalies and diseases.⁶

This study investigated the definition, variation, course, type, and class of palmar creases according to their relations with each other.

MATERIALS AND METHODS

This study was approved by the Research Ethics Committee of Karadeniz Technical University (No: 2016/23 & Date: 21.3.2016). Permission was obtained from the Faculty of Medicine of the university.

Sampling

The sample comprised 753 right and left hands of 377 participants (222 females and 155 males). Participants were first-, second-, and third-year students recruited from the faculty of medicine of the university. Students with scars on their palms were excluded. Participation was voluntary. Informed consent was obtained from all participants. Their palms were scanned using a scanner (Hewlett Packard Deskjet Ink Advantage 4615) at a resolution of 600×600 dpi with 24-bit color/8-bit grayscale. The data were analyzed using a computer with a 1.3 GHz Intel Core i5 processor (MacBook Air).

Image Analysis

Each hand was positioned on the scanner with the fingers spread apart in abduction to view the palmar creases. The scanner surface was wiped after each scan to ensure no traces were left behind. The image displayed the start and end points of the palmar creases. Both hands were imaged individually. The images were classified according to the type and location of the palmar creases.

Classification

Distal and Proximal Transverse Creases

The distal and proximal transverse creases were classified as normal, forked, cascade, branched, broken, and accessory (Figures 1 and 2).^{5,6}

The distal transverse crease of the normal type originates from the ulnar border and extends in a gentle concave arc. The normal proximal transverse crease originates from the radial border and extends in a soft concave arc. The proximal and distal transverse creases

of the forked type bifurcate towards the end. The proximal and distal transverse creases of the cascade type are not straight but broken. The proximal and distal transverse creases of the branched type branch. The proximal and distal transverse creases of the broken type have broken points in certain parts. The proximal and distal transverse creases of the accessory type are classified based on the presence of an accessory crease that extends more than half the length of the transverse crease and runs parallel to it.

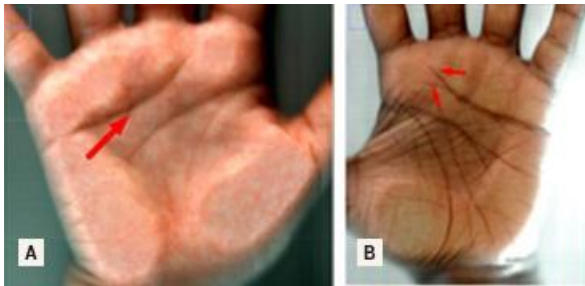


Figure 1: Distal transverse creases; A: normal, B: forked

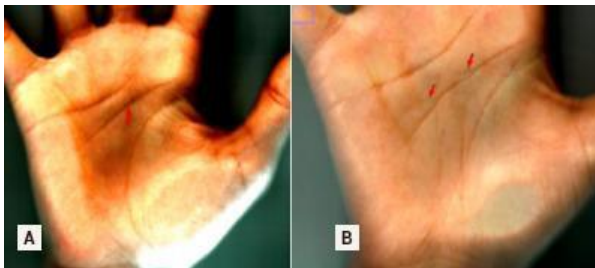


Figure 2: Proximal transverse creases; A: normal, B: forked

Thenar Crease

The thenar crease is classified as normal, double, forked, cascade, branched, broken, and short (Figure 3).^{5,6}

The thenar crease of the normal type forms a single concave arc directed toward the thumb. The thenar crease of the double type forms a double concave bow towards the thumb. The thenar crease of the forked type bifurcates towards the end. The thenar crease of the broken type has broken points in certain parts. The thenar crease of the branched type branch. The thenar crease of the cascade type has the cascade creases broken from the thenar crease.^{5,6}

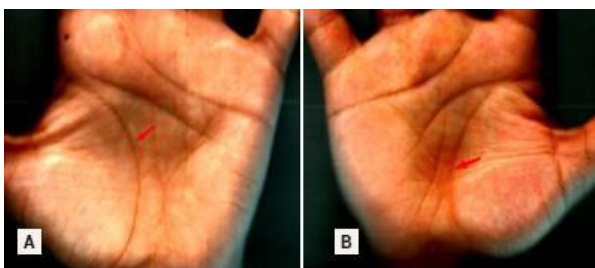


Figure 3: Thenar crease; A: normal, B: forked

Classification based on the location of the proximal transverse and thenar creases on the radial side

The proximal transverse and thenar creases on the radial side are classified as closed, open, and meeting (Figure 4).⁵

The proximal transverse and thenar creases of the closed type are common at the radial border. The proximal transverse and thenar creases of the open type are separate. The proximal transverse and thenar creases of the meeting type meet at the radial border of the palm.⁵

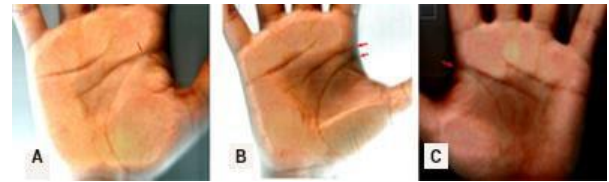


Figure 4: Proximal transverse and thenar creases on the radial side; A: closed, B: open, C: meeting

Classifications based on the location of the proximal and distal transverse creases

The proximal and distal transverse creases are classified as normal, Simian, Sydney, Suwon, connected, close, and cascade (Figure 5).^{5,6}

The proximal and distal transverse creases of the normal type do not meet.⁵ The proximal and distal transverse creases of the simian type form a single crease and extend across the palm.^{5,6} The proximal and distal transverse creases of the connected type are connected by a line inclined toward the hypothenar and thenar ridges.⁶ The proximal and distal transverse creases of the close type are separated from each other, but appear as close lines that seem to fuse.⁶ The proximal and distal transverse creases of the cascade type consist of several partially overlapping transverse lines.⁶ The proximal and distal transverse creases of the Sydney type meet. The proximal and distal transverse creases of the accessory type accompany distally.⁵ The proximal and distal transverse creases of the Suwon type meet and accompany proximally.⁵

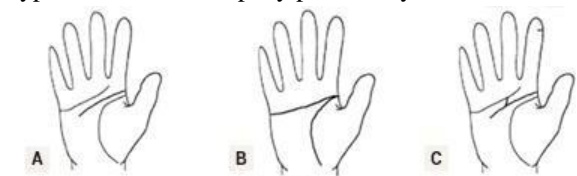


Figure 5: Proximal transverse and distal transverse creases; A: normal, B: simian, C: connected

Statistical Analysis

The data were analyzed using the Statistical Package for Social Sciences (SPSS 24.0) at a significance level of 0.05. The data were presented as numbers and percentages. The Chi-square test was used to compare

the categorical data. Statistical significance value was accepted as $p < 0.05$.

RESULTS

The palmar creases were recorded using a scanner. Categorical values were obtained according to the points determined for each right and left hand. More than half of the participants were females ($n=222$; 58.9%). Male and female participants had a mean age of 20.29 ± 1.84 and 19.84 ± 1.26 years, respectively.

The distal transverse, proximal transverse, and thenar creases were predominantly of the forked type, regardless of gender (Tables 1, 2, and 3).

The results showed that the most common proximal and distal transverse creases in the right hand were of the connected type, while the most common proximal and distal transverse creases in the left were of the normal type (Table 4).

The proximal transverse and thenar creases on the radial side in the right and left hands were predominantly of the closed type (Table 5).

The distal and proximal transverse creases in the right and left hands were predominantly of the forked type. There was a significant difference in the prevalence of thenar creases between the right and left hands ($p = 0.010$, $p < 0.05$) (Table 6).

Table 1: Comparison of right and left hand distal transverse creases by gender

DIS. TYPE	Female		Male		Total	
	n	%	n	%	n	%
R Normal	60	27.4	33	21.3	93	24.9
R Forked	115	52.5	91	58.7	206	55.1
R Cascade	30	13.7	19	12.3	49	13.1
R Branched	13	5.9	8	5.2	21	5.6
R Broken	1	0.5	2	1.3	3	0.8
R Accessory	0	0	2	1.3	2	0.5
L Normal	51	23.1	19	12.4	70	18.7
L Forked	114	51.6	84	54.9	198	52.9
L Cascade	38	17.2	42	27.5	80	21.4
L Branched	14	6.3	7	4.6	21	5.6
L Broken	2	0.9	0	0	2	0.5
L Accessory	2	0.9	1	0.7	3	0.8

DIS: Distal transverse, R: Right, L: Left

Table 2: Comparison of right and left hand proximal transverse creases by gender

PRO. TYPE	Female		Male		Total	
	n	%	n	%	n	%
R Normal	69	31.5	41	26.5	110	29.4
R Forked	129	58.9	110	71.0	239	63.9
R Cascade	1	0.5	0	0.0	1	0.3
R Branched	16	7.3	2	1.3	18	4.8
R Accessory	4	1.8	2	1.3	6	1.6
L Normal	91	41.2	62	40.5	153	40.9
L Forked	121	54.8	87	56.9	208	55.6
L Cascade	1	0.5	0	0	1	0.3
L Branched	6	2.7	2	1.3	8	2.1
L Accessory	2	0.9	2	1.3	4	1.1

PRO: Proximal transverse, R: Right, L: Left

Table 3: Comparison of right and left hand thenar creases by gender

THE. TYPE	Female		Male		Total	
	n	%	n	%	n	%
R Normal	44	19.9	29	18.7	73	19.4
R Double	1	0.5	3	1.9	4	1.1
R Forked	159	71.9	113	72.9	272	72.3
R Broken	6	2.7	1	0.6	7	1.9
R Short	6	2.7	2	1.3	8	2.1
R Branched	1	0.5	2	1.3	3	0.8
R Cascade	4	1.8	5	3.2	9	2.4
L Normal	58	26.1	41	26.5	99	26.3
L Double	9	4.1	1	0.6	10	2.7
L Forked	138	62.2	91	58.7	229	60.7
L Broken	7	3.2	3	1.9	10	2.7
L Short	7	3.2	13	8.4	20	5.3
L Branched	0	0	1	0.6	1	0.3
L Cascade	3	1.4	5	3.2	8	2.1

THE: Thenar, R: Right, L: Left

Table 4: Comparison of the location of proximal transverse crease and distal transverse creases by gender

	Female		Male		Total	
	n	%	n	%	n	%
R Normal	100	45.2	68	43.9	168	44.7
R Simian	2	0.9	2	1.3	4	1.1
R Sydney	0	0	1	0.6	1	0.3
R Connected	119	53.8	81	52.3	200	53.2
R Close	0	0	3	1.9	3	0.8
L Normal	104	46.8	84	54.2	188	49.9
L Simian	4	1.8	3	1.9	7	1.9
L Connected	107	48.2	63	40.6	170	45.1
L Close	7	3.2	5	3.2	12	3.2

R: Right, L: Left

Table 5: Comparison of the types of right and left hand proximal transverse crease and thenar crease according to location on the radial side by gender

	Female		Male		Total	
	n	%	n	%	n	%
R Closed	126	57.0	116	74.8	242	64.4
R Open	77	34.8	27	17.4	104	27.7
R Meeting	18	8.1	12	7.7	30	8.0
L Closed	130	58.6	115	74.2	245	65
L Open	73	32.9	21	13.5	94	24.9
L Meeting	19	8.6	19	12.3	38	10.1

R: Right, L: Left

Table 6: Comparison of thenar crease types according to right and left hands

THE. TYPE	Right Hand		Left Hand		Total		P value
	n	%	n	%	n	%	
Normal	73	42.4	99	57.6	172	100	0.010*
Double	4	28.6	10	71.4	14	100	
Forked	272	54.3	229	45.7	501	100	
Broken	7	41.2	10	58.8	17	100	
Short	8	28.6	20	71.4	28	100	
Branched	3	75.0	1	25.0	4	100	
Cascade	9	52.9	8	47.1	17	100	
Total	376	49.9	377	50.1	753	100	

THE: Thenar, R: Right, L: Left

(* $p < 0.05$)

The results showed that proximal and distal transverse creases were more predominantly of the connected type in the right hand than in the left hand.

The proximal transverse and thenar creases of the closed type were more common in the left hand than in the right hand.

DISCUSSION

The results showed that palmar creases differed by their characteristics and analysis groups. This study made a wide classification (normal, forked, cascade, branched, broken, and accessory) for distal and proximal transverse creases.^{5,6}

The distal transverse creases originate from the ulnar side on both right and left hands. Then, they continue in the form of a concave arc proximally toward the ulnar border. Park et al. found that the distal transverse creases were predominantly of the normal type, followed by the branched and forked types.⁵ Alter et al. reported that the distal transverse creases were predominantly of normal type, followed by the forked type.⁶ Afework determined that the distal transverse creases were predominantly of the normal type, followed by the cascade type. He also noted that the cascade type was insignificantly more common on the left than on the right.¹⁵ Ranjit et al. detected that the distal transverse creases were predominantly of the branched type, followed by the normal type.¹⁶ Our results indicated that the distal transverse right and left palmar creases were predominantly of the forked type, regardless of gender (Table 1).

Our results showed that the proximal transverse crease originated from the radial side of both hands. Then, it extended in the form of a concave arc proximally toward the ulnar border. Park et al. found that the proximal transverse creases were predominantly of the normal type, followed by the branched and forked types.⁵ Alter et al. reported that the proximal transverse creases were predominantly of the normal type. They also noted that the proximal transverse creases were more common in the left palm, especially in females.⁶ Afework determined that the proximal transverse creases were predominantly of the branched type after the normal type.¹⁵ Ranjit et al. reported that the proximal transverse creases were predominantly of the branched type.¹⁶ However, our results showed that the proximal transverse creases on both right and left palms were predominantly of the forked type, regardless of gender (Table 2). We also observed proximal transverse creases of the forked type on both right and left hands. We observed no proximal transverse creases of the broken type.

This study made a broad classification (normal, double, forked, cascade, branched, broken, and short) for thenar creases.^{5,6}

Park et al. found that the thenar creases were predominantly of the normal type, followed by the forked type.⁵ Alter et al. reported that the thenar creases were predominantly of the normal type, followed by the double and forked types.⁶ Afework detected that the thenar creases were predominantly of the accessory type after the normal type.¹⁵ Ranjit et al. determined that the thenar creases were predominantly of the branched type, followed by the normal type.¹⁶ However, our results showed that the thenar creases were predominantly of the forked type, regardless of gender (Table 3). Our results also indicated that the thenar creases were predominantly of the forked type on both hands. There was a significant difference in the prevalence of thenar creases between the right and left hands ($p=0.010$, $p<0.05$) (Table 6).

Alter et al. classified the proximal and distal transverse creases as normal, Simian, Sydney, cascade, connected (hypothenar, thenar, etc.), and close.⁶ Park et al. classified the proximal and distal transverse creases as normal, Simian, Sydney, and Suwon and its subtypes.⁵ We also classified the proximal and distal transverse creases as normal, Simian, Sydney, Suwon, connected, close, and cascade. Alter et al. found that the proximal and distal transverse creases were predominantly of the normal type, followed by the connected hypothenar.⁶ Park et al. reported that the prevalence of proximal and distal transverse creases of the normal type was 84.4%. They also noted that the proximal and distal transverse creases were more common in the left hand than the right hand in females.⁵ Afework detected that the prevalence of proximal and distal transverse creases of the normal, Simian, Suwon, and Sydney types was 86.2%, 6.3%, 4.1%, and 3.5%, respectively. These variations were not significant, although the frequencies of palmar creases differed between males and females as well as on both sides.¹⁵ Ranjit et al. found that the proximal and distal transverse creases were predominantly of the normal type on the right and left palms of both sexes. They stated that the prevalence of normal, Simian, and Sydney creases showed a significant relationship only between the left and right hands in males.¹⁶ Alhaji et al. determined that the prevalence of proximal and distal transverse creases of the normal type on the right palm was 88.5% (86.4% in males and 90.9% in females). On the contrary, they also noted that the prevalence of proximal and distal transverse creases of the normal type on the left palm was 89% (87.2% in males and 90.9% in females).¹⁴ However, our results showed that the proximal and distal transverse creases of the connected type were predominant on the right hand, while those of the normal type were predominant on the left hand (Table 4). Our results also showed that the proximal and distal transverse creases of the connected type were more

common on the right hand than on the left. Alter et al. found the prevalence of proximal and distal transverse creases of the cascade type was 0.5%.⁶ However, we observed no proximal and distal transverse creases of the cascade type.

Alter et al. detected that the prevalence of proximal and distal transverse creases of the Simian type was 1.3%. They found five proximal and distal transverse creases of the Simian type in females.⁶ Park et al. reported that the proximal and distal transverse creases of the Simian type were most common (12.6%). They also noted that the proximal and distal transverse creases of the Simian type were more common in males than in females, and on the right hand than on the left.⁵ Ranjit et al. found that the proximal and distal transverse creases were predominantly of the Simian type.¹⁶ Oyinbo et al. detected proximal and distal transverse creases of the Simian type in 4.1% of individuals of Ijaw ethnicity in South-South Nigeria.¹⁷ Sharma et al. determined that the proximal and distal transverse creases of the Simian type were the most common variation in the Central Indian population.⁷ Sharma et al. found the prevalence of proximal and distal transverse creases of the Simian type to be 14.4%.⁷ Adetona et al. noted that 0.5% and 0.2% of the proximal and distal transverse creases of the Simian type were on the right and left hand, respectively, among Nigerians.¹⁸ Alhaji et al. detected that the proximal and distal transverse creases were predominantly of the Simian type [7.8% on the right palm (8.6% male, 6.8% female)]. Moreover, they were on the left palm [8.2% (9.1% male, 7.3% female)].¹⁴ Our results showed that the proximal and distal transverse creases of the Simian type were more common than those of the Sydney type. Moreover, the proximal and distal transverse creases of the Simian type were more common in males than in females. Our results also showed that the proximal and distal transverse creases of the Simian type were more prevalent on the left hand than on the right (Table 4).

Alter et al. reported that the prevalence of proximal and distal transverse creases of the Sydney type was 2.8% , while Park et al. found it to be 2.5%.^{5,6} Oyinbo et al. and Sharma et al. determined that the prevalence of proximal and distal transverse creases of the Sydney type was 0.19% and 3.6%, respectively.^{7,17} Alhaji et al. found that the least common palmar crease was of the Sydney type.¹⁴ Park et al. reported that the proximal and distal transverse creases of the Sydney type were common in males than in females.⁵ We observed only one proximal and distal transverse crease of the Sydney type on the right hand of a male participant (Table 4). Park et al. found that the prevalence of proximal and distal transverse creases of the Suwon type was 0.5%. Moreover, they observed them only in males.⁵ Sharma et al. reported that prevalence of proximal and distal

transverse creases of the Suwon type was 2.4%.⁷ However, we did not detect any proximal and distal transverse creases of the Suwon type.

Oyinbo et al. stated that the physical anthropology feature differs across populations.¹⁷ Palmar creases help us reveal the anthropological features of different ethnicities. Researchers suggest that race, gender, and age affect the expression of palmar crease patterns.⁶ Variations in palmar crease types observed through comparisons may reflect genetic traits, anthropological characteristics of different populations, and geographical differences.

This study investigated the radial location of both proximal transverse and thenar creases. We classified them in to three groups: open, closed, and meeting.⁵ Park et al. reported that the proximal transverse and thenar creases of the closed type were more common in males than in females, while those of the open and meeting types were more common in females than in males.⁵ Ranjit et al. found that the proximal transverse and thenar creases of the closed type were predominant and showed a significant relationship between the left and right hands.¹⁶ They also detected that the proximal transverse and thenar creases of the closed type were more common in males than in females, while it was the opposite for those of the open type. Park et al. reached similar results with the Korean population.^{5,16} Our results showed that the proximal transverse and thenar creases on the radial side were predominantly of the closed type on both hands (Table 5). Our results also showed that the proximal transverse and thenar creases on the radial side were more common on the left hand than on the right hand.

Nazarabadi et al. reported that the Simian creases were observed significantly more frequently in individuals with Down syndrome.¹³ The simian creases can be detected by practical use and fast analysis of palmar creases because palmar creases develop during embryonic life. The analysis of palmar creases can help us detect chromosomal disorders at an early stage.

We defined the location of the distal transverse, proximal transverse, and thenar creases and their relations with each other. We made a broad classification for a detailed analysis. Defining the location of palmar creases may help us with hand surgery. The numbers, types, and relations of palmar creases may be an indicator for the early detection of chromosomal aberrations together with other diagnostic applications. Therefore, we believe that this study will contribute to the literature and pave the way for further research.

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

Researchers' Contribution Rate Statement: Concept/Design: NA, MHU; Analysis/Interpretation: NA, MHU; Data Collection: NA, MHU; Writer: NA, MHU; Critical Review: NA, MHU; Approver: NA, MHU

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Ethical Approval: The study protocol was approved by the Scientific Research Ethics Committee of Karadeniz Technical University (Date: 21.3.2016 & No: 2016/23)

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