대 한 체 질 인 류 학 회 지
Korean J Phys Anthropol
18(4): 000 ~ 000, 2005

Dermatoglyphic Characteristics of Patients with Rheumatoid Arthritis

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Rheumatoid arthritis (RA), which is frequently involved in the articulations of the hands and feet, is known to be related with inheritance. Dermatoglyphics, the patterns of ridges on the skin of the fingertips, palms, and soles, are mostly related with inheritance. The purpose of this study is to verify the possibility that dermatoglyphics are helpful for the diagnosis of RA.

We attempted to compare the characteristics of the fingerprints, palmprints, and palm creases in 67 Korean RA patients (RA group) to those in 3,216 normal Korean persons. In the RA group, the radial loop and whorl were more frequent whereas the arch and ulnar loop were less frequent. The total fingerprint ridges were more numerous and 11 palmprint D type was more frequent in the RA group. Also, the Simian and Sydney creases were more frequent and the total degree of palm crease transversality was lower in the RA group. In addition, a part of the dermatoglyphic characteristics of the Korean RA group are different from those of the Indian RA group.

These results suggest that dermatoglyphics may be helpful in the diagnosis of Korean RA patients.

Key words : Dermatoglyphics, Fingerprint, Palm crease, Palmprint, Rheumatoid arthritis

Introduction

Rheumatoid arthritis (RA), which is a common inflammatory joint disease, is frequently involved in the articulations of the hands and feet. The etiology of RA is not clear, but RA is known to be related with inheritance (Grant et al. 2001). Similarly, dermatoglyphics, i.e., fingerprint, palmprint, and palm crease, are involved in the hands and related with inheritance (Penrose 1963, Alter 1967, Preus & Fraser 1972, Loesch 1974, Ravindranath et al. 2003). Therefore, we assume that dermatoglyphics may be helpful in the diagnosis of RA. The purpose of this research is to find out the roles of fingerprints, palmprints, and palm creases in the diagnosis of RA, which have not been extensively researched before.

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Materials and Methods

Sixty-seven patients with RA (RA group) and 3,216 normal persons were chosen as subjects. The RA group (males: 57, females: 10, average age: 29.2 years old) was diagnosed with RA according to the American Rheumatism Association 1987 revised criteria (Arnett et al. 1988). Normal healthy Korean persons (males: 2,095, females: 1,121, average age:

20.3 years old) were chosen for the control group.

The fingerprints, palmprints, and palm creases were imprinted on paper. Palmar surfaces of the fingers and palms were washed with soap, then dried and smeared with water-soluble ink. Fingerprints of ten fingers were imprinted on paper; each finger was rolled side-to-side so the fingerprints near fingernail were imprinted. Successively, the palmprints and palm creases in both hands were imprinted on paper; each palm was not allowed to be cupped or extended (Uchida & Soltan 1963).

The fingerprints, palmprints, and palm creases imprinted on paper were qualitatively and quantitatively examined according to the method of physical anthropology as follows.

Fingerprint types (arch, radial loop, ulnar loop, and whorl) were identified by examining the triradius number and loop direction. In the arch, the fingerprint ridges were none because there is no triradius; and in the whorl, the fingerprint ridges were counted along the straight line between the fingerprint center and distal triradius (Chung et al. 1995).

Palmprint D-C-B type was identified by tracking ridges D, C, B originating from triradii d, c, b, respectively. In the case when there was no triradius, the type was defined as O; and in the case when a ridge was terminated at another ridge, the type was defined as X. Palmprint ridges a-b, b-c, c-d were counted along the straight line between adjacent triradii. In addition, palmprint angle atd was measured on the basis of triradii a, t, d (Chung et al. 1995).

Palm crease types (closed, open, and meeting creases) were identified by examining the relationship between the radial longitudinal crease and proximal transverse crease. Other types (normal, Simian, and Sydney creases) were identified by examining the

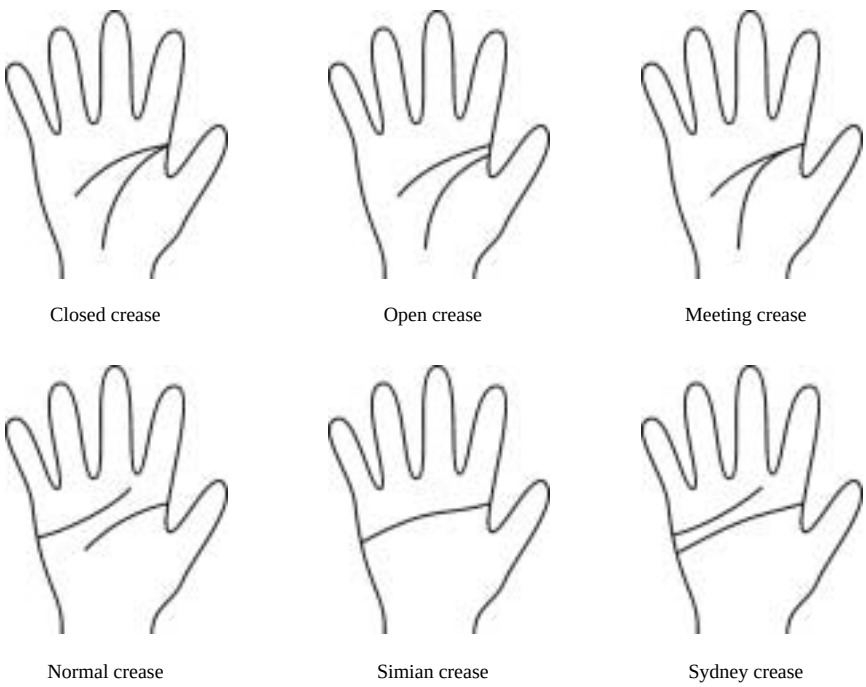

Fig. 1. Palm crease types according to the relationship of radial longitudinal crease and proximal transverse crease (top row) or according to the relationship of proximal transverse crease and distal transverse crease (bottom row).

relationship between the proximal transverse crease and distal transverse crease (Fig. 1) (Alter 1970, Dar et al. 1977, Chaube 1977). The total degree of palm crease transversality was calculated on the basis of coordinates on both start points and end points of the radial longitudinal crease, proximal transverse crease, and distal transverse crease (Dar & Schmidt 1976).

Characteristics of the fingerprint, palmprint, and palm crease were compared between the RA group and control group. In order to compare the frequencies of fingerprint types, palmprint types, and palm crease types, Chi−square test was performed. A triangle graph was drawn to evaluate the frequencies of palmprint D type (Olivier 1969). In order to compare the total fingerprint ridges, palmprint ridges, palmprint angle atd, and total degree of palm crease transversality, unpaired t−test was performed. The data was

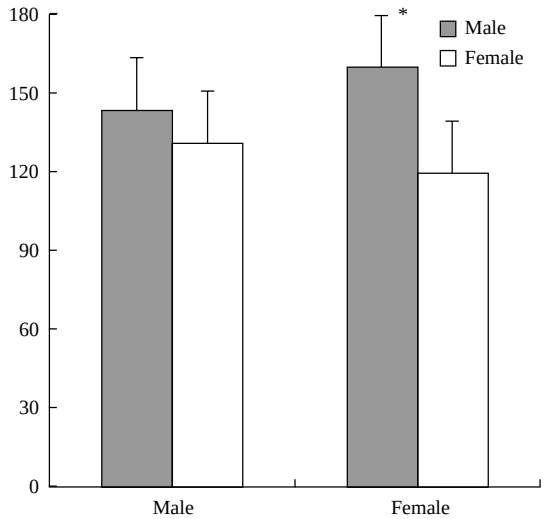

Fig. 2. Total fingerprint ridges in the rheumatoid arthritis (RA) (41 cases) and the control (557 cases). Between the RA and the control, $P < 0.05$*.

RA 34.7%***
Control 38.3%***

RA 14.7%***
Control 24.4%***

RA 11.6%***
Control 3.4%***

RA 8.4%***
Control 9.5%***

RA 3.2%***
Control 2.5%***

Others

RA 27.4%***
Control 21.9%***

Fig. 3. Frequencies of palmprint D−C−B types in the rheumatoid arthritis (RA) and the control. $P < 0.001$***

Table 1. Frequencies of fingerprint types in the rheumatoid arthritis (RA) and the control

		Arch	Radial loop	Ulnar loop	Whorl	Total	(Cases)
Total	RA	2.0%***	5.0%***	42.0%***	51.0%***	100.0%	(616)
	Control	2.9%***	3.8%***	50.4%***	42.9%***	100.0%	(30,978)
Male	RA	2.1%**	5.1%**	41.0%**	51.8%**	100.0%	(525)
	Control	2.7%**	4.2%**	49.1%**	44.0%**	100.0%	(20,164)
Female	RA	1.1%	4.4%	48.3%	46.2%	100.0%	(91)
	Control	3.4%	3.1%	52.7%	40.8%	100.0%	(10,814)
Right	RA	1.0%***	6.3%***	39.9%***	52.8%***	100.0%	(301)
	Control	2.4%***	3.6%***	49.5%***	44.5%***	100.0%	(15,546)
Left	RA	2.9%*	3.8%*	44.1%*	49.2%*	100.0%	(315)
	Control	3.5%*	4.0%*	51.3%*	41.2%*	100.0%	(15,432)
First finger	RA	0.8%	0.8%	30.4%	68.0%	100.0%	(125)
	Control	2.0%	1.5%	39.4%	57.1%	100.0%	(6,115)
Second finger	RA	6.3%	16.4%	32.0%	45.3%	100.0%	(128)
	Control	6.5%	13.6%	36.7%	43.2%	100.0%	(6,228)
Third finger	RA	2.5%**	0.0%**	50.0%**	47.5%**	100.0%	(120)
	Control	3.9%**	2.4%**	59.6%**	34.1%**	100.0%	(6,262)
Fourth finger	RA	0.0%	0.0%	35.0%	65.0%	100.0%	(117)
	Control	1.2%	0.9%	41.4%	56.5%	100.0%	(6,177)
Fifth finger	RA	0.0%***	7.1%***	62.7%***	30.2%***	100.0%	(126)
	Control	1.0%***	0.5%***	75.2%***	23.3%***	100.0%	(6,196)

Between the RA and the control, $P < 0.05$*, $P < 0.01$**, $P < 0.001$***

analyzed using SPSS software (Release 11.0, Chicago, IL) and $p < 0.05$ was regarded as statistically significant.

Results

In the RA group, the radial loop and whorl were more frequent whereas the arch and ulnar loop were less frequent; these characteristics of the radial loop and whorl were prominent in the right hand and fifth finger. The frequency of the radial loop was reversed in their left hands and the third fingers (Table 1). The total fingerprint ridges were more numerous in the RA group (Fig. 2).

Among palmprint D−C−B types, 11−X−7 and 11−O−7 were more frequent whereas 7−5−5, 9−7−5, and 11−9−7 were less frequent in the RA group (Fig. 3). Among palmprint D types, 11 was more frequent whereas 9 and 7 were less frequent in the RA group

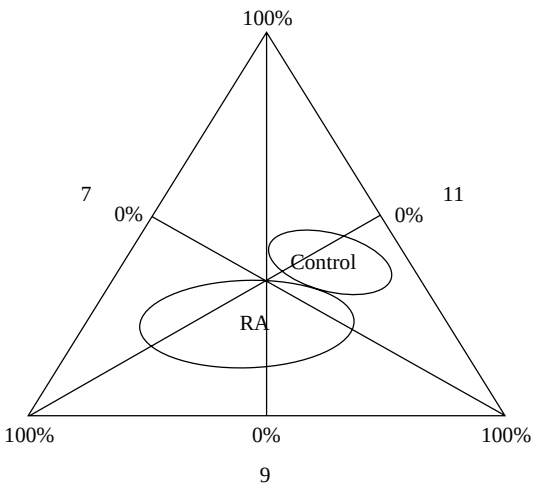

Fig. 4. Triangle graph showing the frequencies of palmprint D types in the rheumatoid arthritis (RA) and the control.

(Fig. 4). Differences of both palmprint ridges and palmprint angle atd between the RA and the control groups were not prominent, except that palmprint

Table 2. Frequencies of the palm crease types in the rheumatoid arthritis (RA) and the control

		Closed Crease	Meeting Crease	Open Crease	Total (Cases)
Total	RA	92.6%	1.6%	5.8%	100.0% (122)
	Control	87.0%	5.2%	7.8%	100.0% (5,202)
		Normal Crease	Simian Crease	Sydney Crease	Total (Cases)
Total	RA	74.6%*	20.9%*	4.5%*	100.0% (110)
	Control	84.4%*	12.6%*	2.5%*	100.0% (5,201)
Male	RA	74.5%	20.2%	5.3%	100.0% (94)
	Control	82.3%	14.1%	3.6%	100.0% (3,537)
Female	RA	75.0%	25.0%	0.0%	100.0% (16)
	Control	88.8%	9.6%	1.6%	100.0% (1,664)
Right	RA	70.2%*	22.8%*	7.0%*	100.0% (57)
	Control	83.0%*	14.2%*	2.8%*	100.0% (2,715)
Left	RA	79.2%	18.9%	1.9%	100.0% (53)
	Control	85.9%	10.9%	3.2%	100.0% (2,486)

$P < 0.05$*

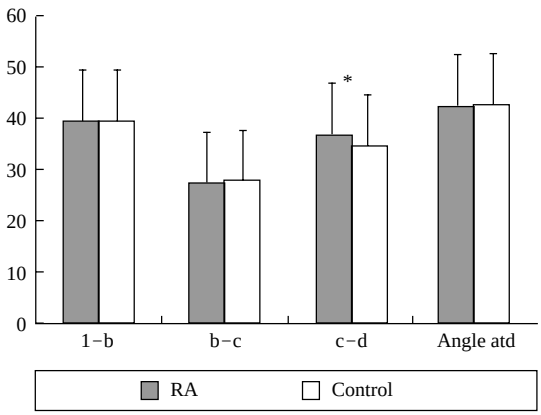

Fig. 5. Palmprint ridges a−b, b−c, c−d and palmprint angle atd (Unit: Degree) in the rheumatoid arthritis (RA) (89 persons) and the control (1,178 persons). $P < 0.05$*.

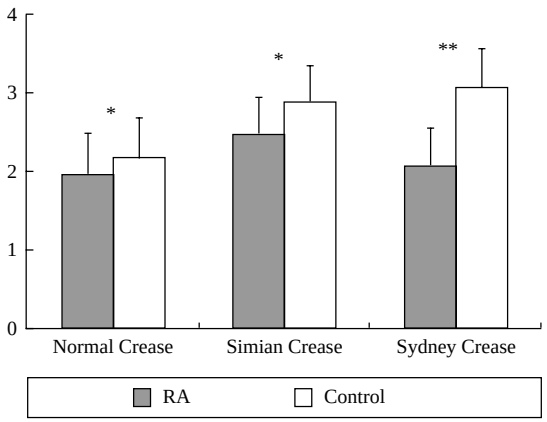

Fig. 6. Total degree of palm crease transversality in the rheumatoid arthritis (RA) (58 persons) and the control (5,176 persons). $P < 0.05$*, and $P < 0.01$**.

ridges c−d was more numerous in the RA group (Fig. 5).

Closed crease was more frequent whereas open and meeting creases were less frequent in the RA group. Normal crease was less frequent whereas Simian and Sydney creases were more frequent in the RA group; the general characteristics were prominent in their right hands. The general characteristics of Sydney crease were reversed in the left hands of female RA group (Table 2). The total degree of palm crease transversality was lower in the RA group; the characteristics of the Sydney crease were more prominent (Fig. 6).

Discussion

The examination of dermatoglyphics does not invo-

lve physical pain or economical burden for patients (Stough & Seely 1969). Moreover, the examination of dermatoglyphics does not involve a consideration of a patient's age because dermatoglyphics does not change during one's life (Holt 1973, Caplan 1990). A person's dermatoglyphics can be scanned and inputted to a computer early on to detect the possibility of certain diseases. Using computer software, fingerprints, palmprints, and palm creases can be identified either automatically or manually. Successively, qualitative and quantitative examinations may be performed automatically. Such an automatic method will be especially helpful in quantitative examination.

Dermatoglyphics are helpful in the diagnosis of various diseases related with inheritance since dermatoglyphics are influenced by genetic factors. For example, the Simian crease is much more frequent in patients with Down's syndrome (Uchida & Soltan 1963, Shiono et al. 1969, Bryant 1970, Dar & Schmidt 1976), and the total fingerprint ridges are numerous in patients with Turner's syndrome (Penrose 1963). Likewise, it is possible that dermatoglyphics can be helpful in the diagnosis of RA, which is known to have genetic factors (Penrose 1963, Alter 1967, Preus & Fraser 1972, Loesch 1974, Ravindranath et al. 2003).

The results show that dermatoglyphics are helpful in the diagnosis of RA because several dermatoglyphic characteristics in patients with RA are statistically different from those in normal persons.

In the RA group, the arch and ulnar loop were less frequent whereas the radial loop and whorl were more frequent (Table 1). The result is closely related with the fact that the total fingerprint ridges were more numerous in the RA (Fig. 2). The total fingerprint ridges are in an inverse proportion to the frequency of the arch and in direct proportion to the whorl. In the female RA group, the arch was much less frequent (Table 1), and total fingerprint ridges were much more numerous than in the male (Fig. 2).

Fingerprint type is decided by the thickening of the fingers' subcutaneous tissue during development as follows. The arch develops if the fingers' subcutaneous tissue does not thicken; the loop develops if it thickens in one side; and the whorl develops if it thickens in both sides (Mulvihill & Smith 1969). In the Korean RA group, the radial loop and whorl were more frequent (Table 1). This result might be related with the thickening of the fingers' subcutaneous tissue in RA patients. It might be valuable to compare the fingerprint types with the amount of the fingers' subcutaneous tissue in RA patients in the near future.

Among palmprint D types, 11 was more frequent in the RA group (Fig. 4). This result is compatible with the result that the Simian crease and Sydney crease are more frequent in the RA group (Table 2) since both the palmprint and palm crease have a tendency to traverse the palm in RA patients (Figs. 1, 3).

In the RA group, the palmprint ridges c–d is more numerous. This result suggests the possibility that the distance between palmprint triradii c and d is longer. Therefore, it is desirable to investigate the relationship between the palmprint ridges, the distance between the palmprint triradii, and the motion range of fingers in RA patients.

The closed crease, Simian crease, and Sydney crease were more frequent in the RA group (Table 2). The result suggests that the palm crease has a tendency to join together in RA patients (Fig. 1). The purpose of the palm crease is to help the palm skin fold and allow free motion of the fingers (Popich & Smith 1970). Therefore, the joining of the palm crease, which results in insufficient palm crease function, might be related to the decreased free motion of the fingers in RA patients.

In the RA group, the total degree of palm crease transversality was lower (Fig. 6). The result was mainly caused by the longitudinally inclined distal transverse crease. The purpose of the distal transverse crease is to allow free motion of the second to fifth

fingers (Popich & Smith 1970). Therefore, the longitudinal inclination of the distal transverse crease might be related to the decreased free motion of the second to fifth fingers in RA patients.

In summary, the frequencies of the fingerprint types, palmprint D type, Simian crease, and Sydney crease as well as the total degree of the palm crease transversality are especially helpful in the diagnosis of RA.

In addition, dermatoglyphics can be used in the diagnosis of RA in terms of racial specificities. The normal dermatoglyphic characteristics are different according to the races and ethnic groups (Kimura 1962, Uchida & Soltan 1963, Olivier 1969, Preus & Fraser 1972, Dar et al. 1977, Sokal & Livshits 1993). For example, the dermatoglyphic characteristics of the Indian RA group are different from those of the Korean RA group as follows: the arch was much more frequent; total fingerprint ridges are less numerous; normal crease is frequent while both Simian and Sydney creases are less frequent (Taneja et al. 1993, Ravindranath et al. 2003). The dermatoglyphic characteristics of the Indian RA group are also different according the sexes and sides from those of the Korean RA group. This suggests that the dermatoglyphic characteristics of RA patients need to be evaluated according to the various races and ethnic groups.

Our study shows that fingerprints, palmprints, and palm creases can be helpful for the diagnosis of RA. A more comprehensive data of large numbers of RA patients, according to the various races and ethnic groups, will give a more comprehensive role to dermatoglyphics in the diagnosis of RA. In the future, research of molecular biology should be performed to reveal the relationship between inheritance of RA and dermatoglyphics.

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Korean J Phys Anthrop
18(4): 000 ~ 000, 2004

류마티스관절염 환자의 피부문 특징

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간추림 : 류마티스관절염은 손과 발의 관절에 잘 생기며, 유전과 관계가 있다. 지문, 손바닥문, 손금으로 이루어진 피부문의 생김새는 유전과 관계가 많다. 이 연구의 목적은 류마티스관절염을 진단할 때 피부문이 도움 되는지 확인하는 것이다.

이 연구에서는 류마티스관절염을 앓고 있는 한국사람 67명과 정상 한국사람 3,216명의 지문, 손바닥문, 손금의 특징을 견주었다.

류마티스관절염 환자의 지문에서는 노쪽고리형과 소용돌이형이 많이 나타났고, 활형과 자쪽고리형이 적게 나타났다. 류마티스관절염 환자에서는 지문의 총피부능선개수가 많았고, 손바닥문 D가 11인 경우가 많았다. 또한 류마티스관절염 환자에서는 손금에서 원숭이손금과 시드니손금이 많았고, 손금의 총가로각도가 작았다. 이러한 류마티즘관절염의 피부문 특징은 인도사람과 다른 점이 있었다.

이 연구의 결과로 한국사람의 류마티스관절염을 진단하는 데 피부문이 도움이 되는 것으로 보인다.

찾아보기 낱말 : 피부문, 지문, 손바닥문, 손금, 류마티스관절염

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