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Short Note

Variability of Plantar Zygodactylous Triradii in Monozygotic and Dizygotic Twins

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Using a special method, the dermatoglyphics of the plantar interdigital areas of 86 monozygotic and 76 dizygotic Polish twin pairs were obtained. The frequencies of different types of zygodactylous triradii were estimated using a recently published new scheme of classification. The second, third, and fourth interdigital areas were grouped together. The findings indicate a high heritability which suggest that zygodactylous triradii might be used as a valuable genetic marker.

Key words: Dermatoglyphics, Zygodactylous triradii, Webbed toes, Twins

Plantar zygodactylous triradii are generally interpreted as micromanifestations of webbing of the toes. They were first described by Cummins and Sicomo [4], Cummins and Midlo [5] and again in greater detail by Penrose and Loesch [6] who gave the symbols z, z′, z″, according to their occurrence in the second, third, or fourth interdigital area, respectively. Aue-Hauser [3] recently developed a scheme of three expression types (Figure) including some triradii (w) so far not counted as being zygodactylous. It is the aim of this study to show the usefulness of this new classification for genetic research.

MATERIALS AND METHODS

A sample of 90 male and 72 female Polish twin pairs from the Anthropological Institute of the Polish Academy of Sciences in Wroclaw were tested for zygosity. Using polysymptomatic analysis of morphological characters and tests for eight blood group systems they were classified into 86 monozygotic (MZ) and 76 dizygotic (DZ) pairs.

The plantar interdigital areas were printed using a special technique [2] because of the difficulties in obtaining good prints of this region. Zygodactylous triradii were classified according to the already mentioned scheme (Fig. 1): (1) The strongest expression(s) shows an interdigital triradius with its

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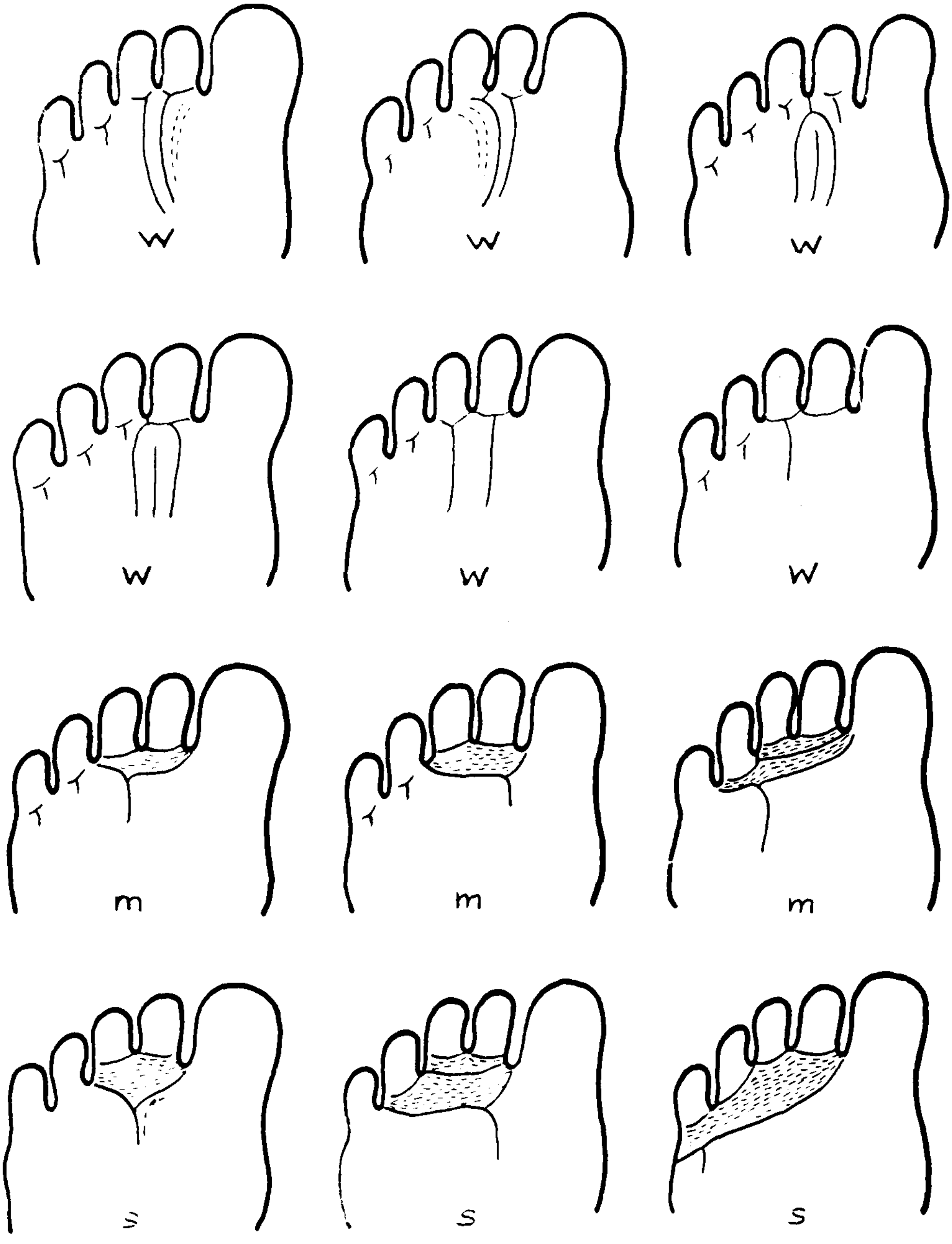

Fig. 1. Variations of the three expression types of zygodactylous triradii. w = weak, m = medium, s = strong expression.

radiants running transversely, the proximal transverse ridge band being rather extended, and with webbing of the toes. (2) The medium expression (m) comprises all variants of triradii with an interdigital position and transverse ridge band, but without webbing of the toes. (3) The weak expression (w) is characterized either by an interdigital triradius, sometimes located proximally and occasionally

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with a longitudinal alignment of one or both radiants, or by a digital triradius translocated transversally. In both cases the proximal transverse ridge band is lacking.

The expression types of zygodactylous triradii on the three interdigital areas were combined and classified into three groups:

I. Absence of zygodactylous triradii in all three interdigital areas (000).

II. Any combination of absent, weak, or medium expression (mwO, mww, etc).

III. Any combination of absent, weak, or medium expression with one or more strong expressions, as well as medium expressions in all three interdigital areas (ssm, sOO, etc).

To measure inter- and intrapair differences the contingency coefficients (CC) and lambda symmetric probability coefficients (λ symmetric) were obtained for all 162 twin pairs.

RESULTS AND DISCUSSION

The present findings in male Polish twins, summarized in Table 1, show a proportional decrease in frequency between groups I, II and III, in agreement with previous findings in 500 male Viennese pupils (Table 2). Also the frequencies of the bilateral combinations of the three groups show the same characteristic decrease, in the male Viennese and in nearly all the partners of the twin pairs (Tables 3 and 4). In all subgroups there was total absence of markedly discordant combinations and a preponderance of identical pattern combinations, as shown in the diagonals of Table 4.

Because significant sexual differences do not exist in frequencies of zygodactylous triradii [1, 6, 7] male and female twins were computed together. Table 5 demonstrates different kinds of correlations between the combinations of the three types of expression, ie, the groups of zygodactylous triradii. The three components of the correlation are: laterality (right–left) in the same subject, same side between cotwins (right–right, left–

TABLE 1. Expression Type Combinations of Plantar Zygodactylous Triradii in Twins by Sex, Zygosity, and Laterality

		MZ male pairs (n = 48)				MZ female pairs (n = 38)			
		Twin A		Twin B		Twin A		Twin B	
Group		R	L	R	L	R	L	R	L
I	n	24	24	23	22	20	15	21	18
	%	50.	50.	47.9	45.8	52.6	39.5	55.3	47.4
II	n	19	16	19	21	15	20	14	17
	%	39.6	33.3	39.6	43.8	39.5	52.6	36.8	44.7
III	n	5	8	6	5	3	3	3	3
	%	10.4	16.7	12.5	10.4	7.9	7.9	7.9	7.9
		DZ male pairs (n = 42)				DZ female pairs (n = 34)			
		Twin A		Twin B		Twin A		Twin B	
Group		R	L	R	L	R	L	R	L
I	n	26	20	20	18	20	19	20	22
	%	61.9	47.6	47.6	42.9	52.6	55.9	58.8	64.7
II	n	12	18	20	22	11	11	13	11
	%	28.6	42.9	47.6	52.4	32.4	32.4	38.2	32.4
III	n	4	4	2	2	3	4	1	1
	%	9.5	9.5	4.8	4.8	3.8	11.8	2.9	2.9

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TABLE 2. Expression Type Combinations of Plantar Zygodactylous Triradii in Male Viennese (n = 500; percent frequencies)

Group	Right	Left
I	50.8	51.2
II	35.0	33.6
III	14.2	15.2

TABLE 3. Bilateral Relations of the Three Groups of Plantar Zygodactylous Triradii in Male Viennese (n = 500; percent frequencies)

L \ R	I	II	III
I	44.8	6.0	
II	6.4	26.8	1.8
III		0.8	13.4

TABLE 4. Bilateral Relations of the Three Groups of Plantar Zygodactylous Triradii in Male Twins (percent frequencies)

MZ male twin pairs (n = 48)

	Twin A			Twin B		
L \ R	I	II	III	I	II	III
I	50.0			43.8	2.1	
II		33.3		4.2	35.4	4.2
III		6.3	10.4		2.1	8.3

DZ male twin pairs (n = 42)

	Twin A			Twin B		
L \ R	I	II	III	I	II	III
I	42.9	4.8		40.5	2.4	
II	19.0	23.8		7.1	42.9	2.4
III			9.5		2.4	2.4

left), and opposite side between cotwins (left–right, right–left). Each Table gives the corrected contingency coefficient (CC) and the lambda symmetric probability coefficient (λ symmetric). CC was calculated because it expresses the strength of the correlation; λ symmetric was calculated in addition, as the three combination groups of the expression types are more likely to correspond to a rank-scale than to a rational scale and λ requires the least assumptions in regard to the scale. However, λ gives the probability of a correct prediction of one expression group assuming the known existence of the other.

The CCs characterizing the correlations between right and left sides of one person show about the same values as those for the relation between MZ twin partners, all ranging from 0.71 to 0.77. Those for DZ twin partners are much lower, their values varying between 0.42 and 0.56. These findings support the hypothesis of high heritability of zygodactylous triradii. The predictability of the expression group of one twin partner from the known one of the cotwin seems to represent a good measure of discrimination between MZ and DZ twins. By means of λ symmetric, it is possible to predict the expression group of MZ partners with a probability ranging from 0.68 to 0.79, while in DZ twin partners the maximal predictability ranges from 0.20 to 0.49.

Our sample size is not large enough to exclude the possibility of bias due to sampling error. However, both statistical measures indicate a high heritability of zygodactylous

TABLE 5. Bilateral and Intrapair Relations of the Three Expression Type Combinations in Twins (percent frequencies)

$A_R \backslash A_L$	MZ twin pairs I	II	III	Total	DZ twin pairs I	II	III	Total
I	45.3	5.8		51.2	46.1	14.5		60.5
II		36.0	3.5	39.5	5.3	23.7	1.3	30.3
III			9.3	9.3			9.2	9.2
Total	45.3	41.9	12.8	100	51.3	38.2	10.5	100
CC	0.76807				0.73247			
λ symmetric	0.8202				0.5224			

$A_R \backslash B_R$	MZ twin pairs I	II	III	Total	DZ twin pairs I	II	III	Total
I	46.5	4.7		51.2	42.1	18.4		60.5
II	4.7	33.7	1.2	39.5	10.5	15.8	3.9	30.3
III			9.3	9.3		9.2		9.2
Total	51.2	38.4	10.5	100	52.6	43.4	3.9	100
CC	0.77355				0.47254			
λ symmetric	0.7857				0.2121			

$A_R \backslash B_L$	MZ twin pairs I	II	III	Total	DZ twin pairs I	II	III	Total
I	41.9	9.3		51.2	42.1	18.4		60.5
II	4.7	33.7	1.2	39.5	9.2	18.4	2.6	30.0
III		1.2	8.1	9.3	1.3	6.6	1.3	9.2
Total	46.5	44.2	9.3	100	52.6	43.4	3.9	100
CC	0.73993				0.42072			
λ symmetric	0.6818				0.1970			

$B_R \backslash B_L$	MZ twin pairs I	II	III	Total	DZ twin pairs I	II	III	Total
I	41.9	9.3		51.2	47.4	5.3		52.6
II	4.7	32.6	1.2	38.4	5.3	36.8	1.3	43.4
III		2.3	8.1	10.5		1.3	2.6	3.9
Total	46.5	44.2	9.3	100	52.7	43.4	3.9	100
CC	0.72499				0.71039			
λ symmetric	0.6591				0.7222			

$A_L \backslash B_L$	MZ twin pairs I	II	III	Total	DZ twin pairs I	II	III	Total
I	40.7	4.7		45.3	40.8	10.5		51.3
II	5.8	36.0		41.9	10.5	26.3	1.3	38.2
III		3.5	9.3	12.8	1.3	6.6	2.6	10.5
Total	46.5	44.2	9.3	100	52.6	43.4	3.9	100
CC	0.74729				0.54150			
λ symmetric	0.7419				0.4110			

$A_L \backslash B_R$	MZ twin pairs I	II	III	Total	DZ twin pairs I	II	III	Total
I	41.9	3.5		45.3	43.4	7.9		51.3
II	9.3	32.6		41.9	9.2	26.3	2.6	38.2
III		2.3	10.5	12.8		9.2	1.3	10.5
Total	51.2	38.4	10.5	100	52.6	43.4	3.9	100
CC	0.75077				0.5611			
λ symmetric	0.7079				0.4932			

triradii. These ridge formations, which have been rather neglected so far, represent a valuable trait for genetic studies. Taking into consideration the results of our investigation, the classification of zygodactylous triradii according to their combined occurrence in the three interdigital areas – called in this paper groups – seems to increase their usefulness. Ongoing family studies might help to get further information as to the mode of inheritance.

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