Dermatoglyphs of Klinefelter's syndrome

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SUMMARY The dermatoglyphs of 28 Japanese with Klinefelter's syndrome [2 XXY; 2 XXYY; 1 XXXY; 1 XXXXY] were compared with 544 male and 129 female controls.

These patients showed high frequencies of fingertip arches pattern, right third interdigital loops, right hypothenar patterns (L') and line C terminating 0 in the right hand.

The mean summed *a-b* ridge count of Klinefelter's syndrome patients was significantly lower than that of the male controls. We suggest that an increase in the number of X or Y chromosomes decreased the *a-b* ridge count in a similar way to the decrease in total finger ridge count.

Several studies on the dermatoglyphs in Klinefelter's syndrome have been reported (Penrose, 1963; Forbes, 1964; Uchida and Soltan, 1963; Holt, 1964, 1968; Cushman and Soltan, 1969). Penrose (1963) and Forbes (1964) found a low total ridge count and an increased number of arches on the fingers. On the other hand, Uchida and Soltan (1963) and Cushman and Soltan (1969) found no characteristic pattern in series of 14 and 55 patients, respectively.

Subjects and methods

Twenty-eight Japanese with Klinefelter's syndrome were studied. The age of the patients with Klinefelter's syndrome ranged from 12 to 67 years.

The chromosomal analyses were conducted by modifications of the method described by Moorhead *et al.* (1960).

The control group consisted of 544 male and 129 female students of Sapporo Medical College and Nurse Training School, aged 22 to 25 years. They were unrelated, all of Japanese origin, and apparently healthy.

Fingerprints were recorded by using the Hollister fingerprint method, and palm prints were recorded with an ink stamp pad.

Results

The clinical and chromosomal features of several patients in this series have already been published

(Takai *et al.*, 1962, 1964, 1965; Shimamura and Hikita, 1965; Sasaki *et al.*, 1967).

The sex-chromosome complements were: XXY (24 cases); XXYY (2 cases); XXXY (1 case); XXXXY (1 case).

DIGITAL PATTERNS

The percentage frequencies of whorls, ulnar and radial loops, and arches on all fingers in Klinefelter's syndrome and those of the male controls are shown in Table 1.

The following results were obtained.

(1) In general, the frequencies of the whorl patterns tended to increase as those of the ulnar and radial loop patterns decreased. The differences between the whorl pattern in Klinefelter's syndrome and those in the control males were not significant (χ^2 3.7; df 1; $P < 0.05$).

(2) The percentage frequencies of arches on all digits in Klinefelter's syndrome were statistically higher than those in the control group (χ^2 43.6; df 1, $P < 0.001$).

PALMAR PATTERNS AND FLEXION

The percentage frequencies of interdigital loops, hypothenar patterns, and thenar patterns of Klinefelter's syndrome patients and both control groups are shown in Tables 2 to 4.

(3) The mean *atd* angle was 44.6° on the left hand and 36.9° on the right hand. There was no significant difference between patients and controls for the *atd* angle; (left: χ^2 0.5 df 1; right; χ^2 0.9 df 1).

Table 1 Percentage frequencies of all digital patterns in Klinefelter's syndrome and in controls

	Klinefelter's syndrome		Controls			
	Shiono (this report) (28 cases)	Holt (1968) (48 cases)	Shiono (this report)		Holt (1968)	
			544 Males	129 Females	Males	Females
Whorl	53.4	24.5	47.7	40.0	27.6	24.4
Ulnar loop	39.3	61.3	47.2	54.5	62.4	63.6
Radial loop	1.1	5.8	3.3	3.4	6.2	5.6
Arch	6.1	7.5	1.8	2.1	3.8	6.4

Table 2 Percentage frequencies of true hypothenar patterns (L^r , A^u/L^r , A^u/L^r) in Klinefelter's syndrome and in controls

Hypothenar patterns	L^r		A^u/L^u		A^u/L^r	
	L	R	L	R	L	R
Klinefelter's syndrome 28 cases)	21.4	32.1	3.6	0.0	0.0	3.6
544 Male controls	18.9	15.5	0.3	0.5	0.0	0.2
129 Female controls	16.2	13.2	0.1	0.1	0.0	0.1

L, Left, R, Right.

(4) The frequencies of true hypothenar patterns (L^r , A^u/L^u , A^u/L^r) in Klinefelter's syndrome and male controls are shown in Table 2. The percentage frequency of right hypothenar patterns (L^r) was statistically significant [χ^2 5.2976, df 1, $0.025 < P < 0.01$].

A hypothenar pattern accompanied by an ulnar triradius was observed on the right palm of only one patient with XXY.

(5) The second, third, and fourth interdigital loops of patients with Klinefelter's syndrome are shown in Table 3. Patients with Klinefelter's syndrome had more third interdigital loops than male controls, this difference being significant on the right (χ^2 4.9, df 1, $P < 0.01$) but not significant on the left (χ^2 0.6, df 1).

(6) The frequencies of the line C terminating in the position 0 were observed in 7.1% of the patients' left hands and in 17.9% of their right hands. In the male controls, the frequencies were 5.8 and 3.2%, respectively (Table 4).

The difference between the percentage frequencies of the line C terminating in the position 0 of the

Table 3 Percentage frequencies of thenar, second, third, and fourth interdigital loop patterns in Klinefelter's syndrome and in controls

	Left palm				Right palm			
	T	2	3	4	T	2	3	4
Klinefelter's syndrome	7.1	0.0	10.7	75.0	0.0	0.0	32.1	64.1
544 Male controls	1.9	0.9	6.7	56.7	0.0	0.4	16.8	50.6
129 Female controls	5.4	3.2	12.1	78.2	3.1	5.3	32.2	67.2

T, thenar pattern.

Table 4 Percentage frequencies of line C terminating in position X, x, and 0

	X and x		0	
	Left	Right	Left	Right
Klinefelter's syndrome	7.1	10.7	7.1	17.9
544 Male controls	8.3	7.2	5.8	3.2
129 Female controls	6.4	5.6	6.2	4.7

X, Main line in which the proximal radiant can be traced for a short distance.

x, No main line, though the triradius is present.

0, Lack of the triradius

right hand in Klinefelter's syndrome and those in male controls was statistically significant [χ^2 12.9, df; $1 P < 0.001$].

(7) The mean total ridge count and the palmar $a-b$ ridge count of Klinefelter's syndrome were shown in Table 5. The mean total ridge count of the XXY patients was very similar to that of the female

Table 5 Means of total ridge counts, $a-b$ ridge counts and atd angles

	Total ridge count		Summed $a-b$ ridge count		Summed atd angle	
	Mean	SD	Mean	SD	Mean	SD
XXY (24 cases)	128.8	45.5	70.1	9.3	81.5	15.9
XXYY (2 cases)	143		66.0		81.0	
XXXY (1 case)	66		55.0		78.0	
XXXXY (1 case)	120		61.0		66.0	
XY (351 cases)	137.7	41.4	74.2	8.1	80.5	15.5
XX (129 cases)	126.5	45.7	73.9	5.5	81.2	15.0

controls. The mean summed *a-b* ridge count of the Klinefelter's syndrome patients was lower than that of the male controls.

Discussion

In their reports on Klinefelter's syndrome, Penrose (1963) and Forbes (1964) noted a slight general tendency towards pattern with low counts and a frequent occurrence of arches on the fingers. But, Uchida and Soltan (1963) and Cushman and Soltan (1969) disagreed with the above findings, and these patients with Klinefelter's syndrome failed to produce anything characteristic.

In the present survey, the presence of arch patterns was a characteristic dermatoglyphic feature of this syndrome. The frequency of whorl patterns on all digits tended to be increased, though the incidence of whorl pattern was found to be higher in Japanese controls than Caucasian controls.

The present two XYY patients showed no arch patterns, though the arch pattern amounted to 14% in the 20 XYY patients reported by Uchida *et al.* (1964), Alter *et al.* (1966), and Shiono (1969). But, a hypothenar pattern accompanied by an ulnar triradius in patients with XYY was the most characteristic feature (Uchida *et al.*, 1964; Alter *et al.*, 1966; Shiono, 1969). The presence of this pattern might, therefore, be helpful in distinguishing the XYY karyotype from the other types of Klinefelter's syndrome. The hypothenar pattern with ulnar triradius was observed on the right hand of only 1 patient of ours with XYY.

As regards total ridge count, Penrose (1967) emphasized that an increase of sex chromosome diminished total ridge count, and the effect of an X chromosome in reducing fingerprint pattern size can be seen to be much greater than the effect of a Y chromosome. The mean total ridge count of the present XYY Klinefelter's syndrome is almost the same as the mean count of the female Japanese population, despite the increased frequency of whorl patterns. However, the mean summed *a-b* ridge count in 28 Klinefelter's syndrome is lower than that of the male controls, as previously reported (Shiono and Kadowaki, 1971; Shiono *et al.*, 1975). Since the mean summed *a-b* ridge count of 28 patients with Klinefelter's syndrome is lower than that of the control group of either sex, we suggest that the summed *a-b* ridge count is reduced by an increase in the number X or Y chromosomes. As suggested by Holt (1968), in order to supplement the information now available on the relations between sex chromosomes and the mean summed *a-b* ridge count, further

patients with aneuploidy of the sex chromosomes should be studied.

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