Topographic approach for analysis of palm crease variants*

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Summary. As the variability and possible clinical significance of palm crease abnormalities receive greater attention, an accurate and objective method for evaluating the palm crease variants is required. A new method is described employing a topographic approach. A network of co-ordinates drawn on the palm prints enables an accurate and reproducible description to be made of unlimited numbers of variants of palm crease configurations. This method makes possible quantitative studies rather than merely qualitative descriptions of the palm crease patterns.

To determine its usefulness, this method was employed in a comparative study of 100 individuals with Down's syndrome and 100 controls. Significantly higher total degree of transversality (T-DoT), as defined in this paper, was found in the Down's syndrome group. T-DoT may be a useful parameter in the evaluation of crease patterns of patients with congenital and genetic disorders.

The clinical significance of palm crease abnormalities is being increasingly recognized. Unusual palm creases have been reported in a wide variety of clinical disorders caused by various genetic and/or environmental factors where the insult occurs early in pregnancy (Rosner, Steinberg, and Sprigge, 1967; Achs, Harper, and Siegel, 1966).

Since considerable variability in palm crease configurations exists in the normal population (Alter, 1970), the availability of an accurate and objective method for description of palm crease variants would be helpful for evaluation of normal and abnormal configurations.

Several of the previously described schemes and formulii for palm crease studies were summarized by Alter (1970). Unfortunately, these methods are inadequate to describe the spectrum of variations in palm crease configuration, which exists in the population.

The topographic approach presented in this communication provides a method which allows the accurate and reproducible description of unlimited numbers of variants. With this method, quantitative as well as qualitative studies of palm crease configurations can be conducted.

This method was tried out on palm prints of 100 patients with Down's syndrome, 100 controls, and 17 normal individuals with typical simian creases, selected from a population of 830 people, which was scored for the presence of this feature.

Method

A grid of co-ordinates is drawn on the palm print. The starting points are A, B, C, as shown in Fig. 1, where A and B represent the postaxial terminations of the proximal creases of the second and fifth fingers, respectively, and location of point C is the vertex of an isosceles triangle. The A-B line is divided into 5 equal portions, each representing 20 arbitrary units used as the horizontal co-ordinates, starting as 0 on the radial side to 100 on the ulnar side of the palm (points A and B, respectively). Squares are drawn based on these segments, and extend proximally along the palm bordering by point C. The longitudinal co-ordinates are also numbered consecutively, starting from 0 at line AB, thus indicating the palm's length/width ratio.

As the palms show a tendency to grow more in length than in width, standards have to be established for each

Received 27 June 1975.
* Supported by a grant from the National Institutes of Health (GM-19100).
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age group. Using the above co-ordinates, the starting and terminating points of the main palm creases are marked from the ulnar side of the palm. In cases of unusual sharp curves, a third intermediate point may be added.

Only the 3 main lines were recorded, and only to the points at which they were wider than 2 epidermal ridges. An example is shown in Fig. 1, where the points of termination of the main lines can be described as: I: 00;22→50;80; II: 00;18→60;37; III: 27;02→100;20.

These co-ordinates can then be used to calculate a potential diagnostic measure, the degree of transversality (DoT), which is the ratio of the transverse distance of the crease divided by its longitudinal distance. The total degree of transversality (T-DoT) is the total transverse distance of the creases divided by their total longitudinal distances. For the creases described in Fig. 1, the T-DoT can be determined as shown in Table I.

![Fig. 1. Normal palm creases. The total degree of transversality is 1.9 in this example (see text).](image)

**TABLE I**

<table>
<thead>
<tr>
<th>Description of Creases</th>
<th>T-DoT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIG. 1</strong></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>00;18→50;60</td>
</tr>
<tr>
<td>II</td>
<td>00;18→100;18</td>
</tr>
<tr>
<td>III</td>
<td>20;12→100;20</td>
</tr>
<tr>
<td>Total:</td>
<td>210-27</td>
</tr>
</tbody>
</table>

The typical simian crease represents the maximal degree of transversality of the two transverse creases.

Description of the creases and calculation of the T-DoT of a palm print of an infant with Down’s syndrome is given in Fig. 2 and Table II.

The maximal T-DoT is observed in cases of absence of the thumbs where a simian crease is often formed and no thenar crease is developed.

**TABLE II**

<table>
<thead>
<tr>
<th>Description of Creases</th>
<th>T-DoT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIG. 2</strong></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>00;18→50;60</td>
</tr>
<tr>
<td>II</td>
<td>00;18→100;18</td>
</tr>
<tr>
<td>III</td>
<td>20;12→100;20</td>
</tr>
</tbody>
</table>

A palm print of a child with the 13q− syndrome is shown in Fig. 3. Description of the creases and calculation of the T-DoT are given in Table II. Palms with variants of simian crease, as well as Sydney lines and their variants have in general a higher T-DoT compared with palms with normal patterns of creases.

Palm creases of many of the patients with Down’s syndrome show a higher T-DoT even when there is no specific abnormality in creases (i.e. simian line or Sydney line and variants) (Fig. 4). This is mainly because of the underdeveloped thenar crease, and the generally transverse shape of the palms in many of the patients with...
FIG. 3. Palm creases of a child with 13q—syndrome with total degree of transversality of ∞ (see Table II).

Fig. 4. Palm creases of a child with Down's syndrome. Despite the absence of a simian crease or Sydney line, the total degree of transversality is high (3.0) because of an underdeveloped thenar crease (see Table II).

Down's syndrome. Since palms of normal people generally show a well-developed thenar crease, those normals with a simian crease still may show a lower T-DoT than patients with Down's syndrome.

Use of the method. (a) **T-DoT in patients with Down's syndrome.** A study of the T-DoT was conducted in 100 patients with Down's syndrome aged 1 month to 35 years. The control group consisted of 100 normal individuals matched for sex and palm width. The results are shown in Table III. The T-DoT is higher in the group of Down's syndrome. The differences are highly significant (t=9.55, P<0.01). The distribution of the T-DoT in the group of Down's syndrome compared with controls is shown in Fig. 5. While only 14% of the normal individuals showed T-DoT (left and right) which is greater than 5.0, 70% of the individuals with Down's syndrome showed this feature.

(b) **T-DoT in normals with simian crease.** In order to investigate the impression that the simian crease per se is not the sole determinant of high T-DoT score in Down's syndrome, we also studied palms with simian crease in normals. A population of 330 normal adults (100 males and 230 females), 200 schoolchildren (100 males and 100 females), and 300 newborns (150 males and 150 females) were scored. Only palms with typical simian creases, defined as an uninterrupted horizontal line crossing the whole palm, were chosen for this study. Seventeen people (14 males and 3 females) had this feature. Three of these had a bilateral simian crease. The results are summarized in Table IV. The T-DoT calculated for the palms with simian crease is significantly lower compared with the T-DoT of patients with Down's syndrome with simian crease, though it is significantly higher compared with palms of normal individuals who do not have a simian crease.

### TABLE III

<table>
<thead>
<tr>
<th>Down's syndrome</th>
<th>Controls</th>
<th>Students' t-Test, Patients with Down's syndrome vs. Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. of Indiv. Studied</strong></td>
<td><strong>T-DoT (Left and Right)</strong></td>
<td><strong>No. of Indiv. Studied</strong></td>
</tr>
<tr>
<td>Males</td>
<td>50</td>
<td>5.9 ± 1.91</td>
</tr>
<tr>
<td>Females</td>
<td>50</td>
<td>6.2 ± 1.75</td>
</tr>
<tr>
<td>Males and females</td>
<td>100</td>
<td>6.0 ± 1.83</td>
</tr>
</tbody>
</table>
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![Graph](image)

Fig. 5. The distribution of total degree of transversality (T-DoT) (left and right) in (a) 100 controls (50 males and 50 females); (b) 100 patients with Down's syndrome (50 males and 50 females).

**TABLE IV**

<table>
<thead>
<tr>
<th>t-value</th>
<th>No. of Palms Studied</th>
<th>Mean T-DoT</th>
<th>Students’ t-Test</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palms of male controls</td>
<td>100</td>
<td>2.0 ± 0.30</td>
<td>3.48</td>
<td>P &lt; 0.01</td>
</tr>
<tr>
<td>Palms of normals with simian crease</td>
<td>20</td>
<td>2.3 ± 0.34</td>
<td>5.0</td>
<td>P &lt; 0.01</td>
</tr>
<tr>
<td>Palms of males with Down’s syndrome with simian crease</td>
<td>37</td>
<td>3.7 ± 1.63</td>
<td>31.0</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

**Discussion**

Several parallels may be drawn between the dermal ridges (dermatoglyphs), an acknowledged diagnostic tool, and the palmar creases. Both the palmar creases and the dermal ridges are formed early in intrauterine life, and develop at approximately the same time (Holt, 1968). The direction of the ridges is thought to be determined by the response to growth forces, the ridges being formed transversely to these forces (Mulvihill and Smith, 1969). Flexion creases are usually formed parallel to the dermal ridges, which suggests that similar factors may influence their direction.

Generalized ridge direction on the palm, either transverse or longitudinal as indicated by the exit of the main lines A and D (Cummins and Midlo, 1961), is known to have clinical significance. In Down’s syndrome, the generalized ridge direction is found to be more transverse (Plato, Ceraghino, and Steinberg, 1973).

Similarly, in Down’s syndrome, as shown in this study, there is a higher T-DoT than is found in normal subjects, indicating a more transverse generalized direction of the palmar creases. Thus, it is shown that this topographic approach which permits quantitative analysis of the palm creases may provide an additional useful parameter in evaluating the potential clinical significance of palmar creases in patients with congenital and genetic disorders.

The authors are grateful to Dr H. M. Nitowsky for his encouragement and advice in this study, and to Mrs Gaye Sachs for her assistance.

This paper includes material submitted in a Ph.D. thesis to the Technion-Israel Institute of Technology, in Haifa.

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doi: 10.1136/jmg.13.4.310

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