Objective Assessment for Digital Clubbing in Caucasian, Negro, and Oriental Subjects

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The ratio of the depth of the index finger at the base of the nail (DPD) divided by the depth at the distal interphalangeal joint (IPD) has been reported useful in evaluating subjects for the presence of digital clubbing. A ratio which exceeds 1 has been considered abnormal. This relationship was independent of age and sex. To determine whether the ratio of DPD/IPD was independent of race, measurements were made of casts of the index fingers of 80 normal subjects: 20 North American Caucasians, 20 Iranians, 20 Negroes, and 20 Orientals. No significant difference was found among mean ratios of North American Caucasians, Negroes, and Orientals. A significantly larger mean ratio in Iranians as compared with Negroes may have been related to the method of selection of the former group. It is concluded that the ratio of DPD/IPD is probably independent of race. These observations further confirm the ratio of DPD/IPD as a method useful in assessing the presence of digital clubbing.

Acquired digital clubbing has long been recognized as a physical sign useful because of its association with certain diseases. It was mentioned as a sign of empyema by Hippocrates. Among children other conditions most commonly associated with digital clubbing have included bronchiectasis, lung abscess, congenital pulmonary arteriovenous fistula, cyanotic congenital heart disease, subacute bacterial endocarditis, biliary cirrhosis, chronic ulcerative colitis, and regional enteritis.

Hereditary digital clubbing, reportedly transmitted as a simple dominant, sometimes possibly with sex limitation and less frequent phenotypic expression in females, often has its onset at or after puberty.

The recognition of digital clubbing has been largely dependent on subjective impressions gained from inspection of the finger heretofore, but recently techniques have been developed which permit accurate, objective assessment of the presence of digital clubbing. These utilize measurements made upon casts of the fingers. Such a cast forms a permanent record of the size and configuration of the finger, complete even to the dermatoglyphic pattern (Fig 1). The relationship between the depth of the index finger at the base of the nail and the depth at the distal interphalangeal joint is the parameter which

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Figure 1. Finger casts of normal index finger of asthmatic child (upper DPD/IPD=0.895) and index finger of child with cystic fibrosis and digital clubbing (DPD/IPD=1.096).
best discriminates between normal subjects and those with diseases commonly associated with digital clubbing.\(^5\) This relationship has been found to be independent of age and sex.\(^6\) The present study was undertaken to establish whether the relationship was also independent of race.

**MATERIALS AND METHODS**

North American Caucasian, Iranian, and Oriental subjects with no history of heart disease, tuberculosis or other chronic pulmonary disease, 20 in each group, were otherwise selected only by availability from medical and paramedical personnel. In the same way, 20 Negro subjects were selected from relatives of patients at the Charity Hospital Pediatric Allergy Clinic. Iranians had been selected for special study after evaluation of finger casts from several Iranian subjects. Ages are indicated for each group in Table 1. Nationalities of the Oriental subjects are shown in Table 2.

Casts of the terminal two phalanges of the left index fingers were prepared by a technique previously described.\(^5,4\) A cylinder formed from half of a 3 x 5 inch filing card sealed with masking tape and closed at one end with a folded 4 x 4 inch gauze square was filled with a smooth, thick paste prepared by the addition of tap water to alginate dental impression powder (Kalginate, type 2 normal set, Teledyne Dental Products). The extended left index finger was inserted deeply into the freshly mixed dental impression material and kept immobile approximately three minutes until the mixture had become firm. The finger was then removed and the mold was filled with cement (Duroc Miracle Stone, The Ransom and Randolph Co), avoiding the introduction of air bubbles. The mold was peeled from the cast when dry (approximately two hours). The maximal expansion of the cement used was 0.05 percent. When there were occasional artifacts due to finger movement or bubbles, another cast was made.

A metric micrometer with a vernier scale was used to measure the distal phalangeal depth (DPD) of the finger cast at the base of the nail and the depth at the distal interphalangeal joint (IPD) (Fig 2). Measurements were accurate to the nearest 0.01 mm. The ratio was calculated by dividing DPD by IPD.

**Table 1—Age of Subjects in Comparative Ethnic Groups**

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. A. Caucasian</td>
<td>30.2</td>
<td>24-37</td>
</tr>
<tr>
<td>Iranian</td>
<td>29</td>
<td>8-41</td>
</tr>
<tr>
<td>Negro</td>
<td>35.4</td>
<td>16-57</td>
</tr>
<tr>
<td>Oriental</td>
<td>29.9</td>
<td>24-36</td>
</tr>
</tbody>
</table>

**Table 2—Nationality of Oriental Subjects**

<table>
<thead>
<tr>
<th>Nationality</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thai</td>
<td>12</td>
</tr>
<tr>
<td>Vietnamese</td>
<td>1</td>
</tr>
<tr>
<td>Chinese</td>
<td>3</td>
</tr>
<tr>
<td>Japanese</td>
<td>4</td>
</tr>
</tbody>
</table>

**RESULTS**

One-way analysis of variance disclosed a significant difference in the mean ratios of DPD/IPD (Table 3). Comparison of the various groups (using the Student t test) indicated that this difference was due to a highly significant difference between the Iranian and Negro subjects only (\(p<0.01\)).

Two subjects had ratios which exceeded 1. One of these was North American Caucasian; the other, Iranian.

The mean ratio of DPD/IPD for the 60 North American Caucasian, Negro, and Oriental subjects was 0.903. The Student t test disclosed no significant difference from the mean ratio of 0.895 reported elsewhere for normal Negro and Caucasian subjects\(^5\) (0.10>\(p>0.05\)), nor did the mean ratio of any of these three groups differ significantly from the previously established normal mean. The mean ratio for the Iranian group was significantly larger than normal (\(p<0.0005\)).

**DISCUSSION**

The mean ratio of DPD/IPD was found to be 0.895, with a standard deviation of 0.041 in a study of 160 normal children and adults, and the ratio was found to be independent of age or sex.\(^5\) Thus, it is convenient to consider any ratio which exceeds 1 (2.5 standard deviations above the normal mean) abnormal.

In North American Caucasian and Negro children, ratios of DPD/IPD exceeding 1 have been found in most children with cystic fibrosis or cystic congenital heart disease. A ratio as high as 1.331 has been found in one child with cystic fibrosis.

**Table 3—Mean Ratios of DPD/IPD with Ranges for Caucasian, Negro, and Oriental Subjects**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>No.</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. A. Caucasian</td>
<td>20</td>
<td>0.911 (± 0.049)</td>
<td>0.825-1.056</td>
</tr>
<tr>
<td>Iranian</td>
<td>20</td>
<td>0.931 (± 0.038)</td>
<td>0.855-1.023</td>
</tr>
<tr>
<td>Negro</td>
<td>20</td>
<td>0.889 (± 0.037)</td>
<td>0.829-0.971</td>
</tr>
<tr>
<td>Oriental</td>
<td>20</td>
<td>0.908 (± 0.044)</td>
<td>0.841-0.986</td>
</tr>
</tbody>
</table>

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On the other hand, ratios slightly greater than 1 were found in only 5 of 119 children with apparently uncomplicated asthma.\(^6\)

The lack of significant differences in mean DPD/IPD ratios of North American Caucasian, Negro, and Oriental subjects in these small groups suggests no major influence of race on this ratio. The detection of only two ratios greater than 1 among the 80 normal subjects further confirms the usefulness of this relationship in evaluating subjects for the presence of digital clubbing.

The significant difference in mean ratios between the Iranian and Negro subjects was partly due to the large mean ratio in the former group, suggesting a possible genetic influence. The group of Iranian subjects was biased in favor of large ratios, however, by the fact that this group was selected for special study because of detection of several relatively large ratios in subjects subsequently included in the study. Random selection of Iranian subjects for study might disclose a smaller mean ratio.

It is concluded that the ratio of DPD/IPD as determined by measurement of casts of the left index finger is probably independent of race. This observation further substantiates the usefulness of this ratio in evaluating subjects for the presence of digital clubbing.

**References**


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**An Eminent Surgeon as a Librarian**

For many years Harvey William Cushing (1869-1939) looked forward to the time when he would have sufficient leisure to catalogue his library and to annotate the books he had been accumulating. He was particularly interested in the provenance of individual copies. He set about in the autumn of 1938 not only to catalogue his entire library, but to make an index of the more interesting sources from which the individual volumes had come. He soon learned the techniques of book description, and some of his detailed collations are masterpieces of minute bibliographic dissection. Unfortunately for those who had later to revise his cards, he had a gay disregard for consistency, but since the problem of putting his catalogue cards into standard form was not too difficult, his original entries, all written in his own hand, are proving invaluable to those who are cataloguing his library.

Fulton, J: Harvey Cushing—A Biography, Springfield, C C Thomas, 1946