Variations in palmar dermatoglyphics among congenital deaf cases: a comparative study

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Abstract

Background: Dermatoglyphics, the scientific study of the origin, development and variation of dermal ridges and patterns on the fingers, palms and soles have been employed to observe association with many congenital defects and genetic diseases. Congenital deafness refers to a hearing loss which is believed to have been present since birth. A congenitally deaf child is also a mute because for normal speech to develop in a child, hearing sensation must be intact. Materials and methods: The study involved 100 congenital deaf and mute children of age groups ranging from 7 years to 20 years. Out of them 50 were males and 50 females. The following parameters were considered after collecting the prints: Digital patterns, digital counts, a-b ridge count (which is done by counting the ridges found at the intersect between point ‘a’- the base of the index finger to point ‘b’- the base of the middle finger), ‘atd’ (angle made by connecting the ‘a’, ‘t’and’d’ triradii points on the palm and ‘dat’ angles (angle made by joining the ‘d’, ‘a’ and ‘t’ triradii points on the palm).

Results: The study revealed considerable decrease in mean TFRC (Total finger ridge count), AFRC (Absolute finger ridge count) and mean ridge count in both male and female deaf cases. The mean atd angle in both cases were increased. The mean (a-b) ridge counts were decreased in both male and female deaf cases. Qualitative analysis revealed increase in arches and decrease in whorls of all cases.

Conclusion: The present study reveals the differences in the dermatoglyphic patterns in congenital deaf cases. The results of this study could be of great importance to clinicians with respect to genetic basis in the identification of the cases at early stages.

Key words: Dermal ridges, Digital patterns, hearing loss, triradii, total finger ridge count, atd angle

Introduction

Dermatoglyphics, the scientific study of the origin, development and variation on dermal ridges and patterns on the fingers, palms and soles have been employed to observe association with many congenital defects and genetic diseases. As palm creases are helpful in discovering anthropologic characteristics and diagnosing several diseases, including chromosomal aberrations, palm creases have been analyzed qualitatively and quantitatively.

Congenital hearing loss merely means that the impairment was present at the time of birth and includes both hereditary as well as acquired cases. The membranous inner ear is of ectodermal derivation. At three weeks, an ectodermal thickening, the otic placode, appears on the lateral surface of the head. By the nine week stage, the basis of the vestibular system, the utricle and semicircular canals, are well established, but the cochlear system lags behind. Development of dermal ridges and congenital deafness seems to be interlinked as they develop at about the same time. Also, the development of the inner ear (5 weeks to 12 weeks) exactly coincides with the development of dermal patterns.

Hearing impairment can have a major impact on the social and emotional development as well as behavioural and academic achievement. The earlier the impairment is identified the better the prognosis. The present study is aimed at determining variations in the dermatoglyphic patterns associated congenital deaf cases compared to that of normal controls.
Materials and Methods

The study involved 100 congenital deaf and mute children of age groups ranging from 7 years to 20 years. Out of them 50 were males and 50 were females. Cases were selected from the deaf schools of Mysore and Hassan. For the controls, 50 male and 50 female students belonging to first year and second year MBBS were selected. Modified ink method of Purvis Smith was adopted to take the palm prints in this study. The procedure was explained to the subjects so that they could cooperate. Both the hands were thoroughly washed with soap and water, and then dried. A small quantity of duplicating ink was spread on the ink pad. The ink from the pad was spread thoroughly with cotton pads by light strokes over each finger tips uniformly. The finger tips then were rolled manually to ensure the foil prints of ridges, over a sheet of executive bond paper which was kept at the edge of the table. Then the ink was smeared over the palm with cotton pads. The ink smeared palm was pressed gently on the slab covered with bond paper.

The same procedure was adopted to obtain the finger and palm prints of the controls. A magnifying hand lens was used to magnify the ridges of the prints for easy identification of the different finger print patterns. A protractor was then used to measure the angles on the palm. The following parameters were considered after collecting the prints : Digital patterns, digital counts, a-b ridge count, (which is done by counting the ridges found at the intersect between point ‘a’ - the base of the index finger to point ‘b’ - the base of the middle finger), ‘atd’ (angle made by connecting the ‘a’, ‘t’ and ‘d’ triradii points on the palm and ‘dat’ angles (angle made by joining the ‘d’, ‘a’ and ‘t’ triradii points on the palm). (Fig. 1& 2). Data analysis was done using Z- Test and Analysis of Variance (ANOVA). For quantitative analysis, tests for statistical significance (x² and t test) were applied to the data of patients as well as controls. (Tables 1 - 3).

Fig.1. method of ascertaining the a-b ridge count with a single triradius ‘a’.

Fig.2. atd angle measurement

Abbreviations : TFRC - Total finger ridge count; AFRC - Absolute finger ridge count ; (a-b) RC - ridge count at the intersect between point ‘a’ - the base of the index finger to point ‘b’- the base of the middle finger; ‘atd’ angle - angle made by connecting the ‘a’, ‘t’ and ‘d’ triradii points on the palm.
### Observations and Results

The observation and the analysis of the palm prints of the 100 deaf children and their controls are presented in the following tables:

### Quantitative analysis

**Table 1:** 5 fingers ridge count in both palms TFRC and AFRC in both palms of congenital deaf and control.

<table>
<thead>
<tr>
<th>Palm side</th>
<th>Deaf males n=50</th>
<th>Control males N=50</th>
<th>P value</th>
<th>Deaf females N=50</th>
<th>Control females N=50</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>mean SD</td>
<td>mean SD</td>
<td>P&lt;0.05</td>
<td>mean SD</td>
<td>mean SD</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>TFRC</td>
<td>114.18 35.27</td>
<td>143.32 45.31</td>
<td></td>
<td>69.58 26.62</td>
<td>91.98 53.22</td>
<td></td>
</tr>
<tr>
<td>AFRC</td>
<td>141.54 59.94</td>
<td>202.26 78.20</td>
<td></td>
<td>150.58 82.92</td>
<td>180.4 110.42</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2:** Mean ridge count and standard deviation of individual fingers, atd angle (a-b)RC and p value in right palm of deaf males and deaf females, control male and control females.

<table>
<thead>
<tr>
<th>Finger tip pattern</th>
<th>Deaf males n=50</th>
<th>Control males N=50</th>
<th>P value</th>
<th>Deaf females N=50</th>
<th>Control females N=50</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>17.42 9.20</td>
<td>24.36 12.15</td>
<td>P&lt;0.05</td>
<td>15.50 8.86</td>
<td>21.58 11.18</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>II</td>
<td>12.42 8.04</td>
<td>17.74 11.76</td>
<td></td>
<td>13.66 7.46</td>
<td>16.28 11.80</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>III</td>
<td>12.06 6.86</td>
<td>16.74 10.17</td>
<td></td>
<td>11.70 7.07</td>
<td>19.08 28.11</td>
<td>not</td>
</tr>
<tr>
<td>IV</td>
<td>16.82 8.52</td>
<td>25.20 13.55</td>
<td></td>
<td>16.36 7.32</td>
<td>21.48 10.55</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>V</td>
<td>12.48 5.57</td>
<td>16.10 8.140</td>
<td></td>
<td>12.28 4.37</td>
<td>13.56 8.42</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>atd&quot;</td>
<td>45.40 6.59</td>
<td>41.98 8.60</td>
<td></td>
<td>47.30 9.60</td>
<td>43.56 8.02</td>
<td>P&lt;0.05</td>
</tr>
</tbody>
</table>

**Table 3:** Mean ridge count and standard deviation of individual fingers, atd angle (a-b)RC and p value in left palm of deaf males and deaf females, control male and control females.

<table>
<thead>
<tr>
<th>Finger tip pattern</th>
<th>Deaf males n=50</th>
<th>Control males N=50</th>
<th>P value</th>
<th>Deaf females N=50</th>
<th>Control females N=50</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>16.80 8.43</td>
<td>22.54 10.19</td>
<td>P&lt;0.05</td>
<td>15.5 8.28</td>
<td>18.9 10.15</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>II</td>
<td>11.02 8.10</td>
<td>16.62 10.22</td>
<td>P&lt;0.05</td>
<td>12.46 8.34</td>
<td>15.68 11.90</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>III</td>
<td>12.48 7.52</td>
<td>18.80 10.63</td>
<td>P&lt;0.05</td>
<td>12.94 7.97</td>
<td>16.60 11.28</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>IV</td>
<td>16.92 8.60</td>
<td>24.86 12.83</td>
<td>P&lt;0.05</td>
<td>16.52 8.37</td>
<td>20.18 11.72</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>V</td>
<td>12.76 5.67</td>
<td>16.70 7.08</td>
<td>P&lt;0.05</td>
<td>13.18 4.27</td>
<td>14.20 7.82</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>atd&quot;</td>
<td>44.96 5.95</td>
<td>43.18 8.66</td>
<td>p&gt;0.05</td>
<td>45.84 9.25</td>
<td>48.40 6.68</td>
<td>p&gt;0.05</td>
</tr>
</tbody>
</table>

| (a-b)              | 36.76 5.49      | 39.08 5.44        | P<0.05  | 34.04 5.73       | 37.56 6.93          | P<0.05  |
Qualitative analysis

In male deaf cases there was an increase in percentage of arches and the loops when compared with the controls. In case of female deaf cases there was an increase in ulnar loops, when compared with controls.

The study of number and percentage of patterns in individual fingers in left palm of deaf male cases shows increase in percentage of arches in second digit (24%) and increase in percentage of loops in first digit (64%). Regarding the right palm in deaf male cases there was an increase in percentage of arches in first and second digits.

The details of patterns in left palm of deaf females and controls show significant increase in arches in first digit (56%), and increase in ulnar loops in third digits (68%), whereas in right palm there was an increase in the ulnar loops in first digit (66%) in female deaf cases.

Detailed analysis of the right palm in deaf and controls show an increase in the arches and ulnar loops (66.4%) and decrease in whorls in male deaf cases. There was an increase in ulnar loops (67.2%) but decrease in whorls pattern in deaf females. The left palm shows increase in arches but decrease in whorls in both male and female deaf cases.

In the left palm, there was an increase in the loops pattern in second inter-digital area in deaf males. In the right palm there was an increase in percentage in loops in second inter-digital area in deaf female. In cases of deaf male there were overall increase in percentage of loops patterns in all areas.

Discussion

The most common forms of genetic deafness are the autosomal recessive forms, accounting for >75% of cases. Autosomal dominant inheritance accounts for a further 10 to 20% of cases, and X linked inheritance for 2 to 3%. Deafness may also be a feature of chromosomal aneuploidy or chromosomal deletion, as well as of mitochondrial inheritance and of mitochondrially determined predisposition to deafness inducing environmental agents. Cummins discovered through his research that dermal, plantar and palmar ridges are unique, unalterable and cannot be duplicated in other people. Congenital deafness refers to a hearing loss which is believed to have been present since birth. A congenitally deaf child is also mute because for normal speech to develop in a child, hearing sensation must be intact.

On examination the mean TFRC and AFRC were decreased in both male and female deaf cases when compared with controls. Which were statistically significant (p<0.05). The mean (a-b) ridge count in male and female cases was found to be decreased when compared with the controls. The mean atd angle in both male and female cases were found to be increased compared to controls. But compared to male cases, mean atd angle was decreased in female cases. In male deaf cases there was an increase in percentage of arches and the loops when compared with the controls. In case of female deaf cases, there was an increase in ulnar loops, when compared with controls. According to Osunwoke et al, ulnar loops had the highest frequency followed by whorls, arches and the least was the radial loops. Athanikar in his study observed predominance of ulnar loop over radial loop on both the hands as per Galton's classification.

Osunwoke et al observed that the percentage frequency distribution of the digital pattern for the ulnar loop in males was 48.68 and 45.78 and females was 55.07 and 66.18 for right and left hands respectively, whorls for males was 31.58 and 38.55 and females was 24.64 and 22.66 for right and left hands respectively, arches for males was 17.11 and 15.66 and females was 15.94 and 11.76 respectively and radial loop for males was 2.63 and females was 4.35 for right and left hands respectively. There was no significant difference (P>0.05) between the male and female subjects in their digital patterns, digital counts and a-b ridge count.

In the study by Osunwoke et al, the mean atd angle for males was 44.51 and 43.17 for right and left hands.
respectively and for females 45.87 and 46.22 right and left hands respectively. The atd angle showed no significant difference (P>0.05) in the right hands but showed a significant difference (P<0.05) in the left hand. In the present study, the mean ridge count and standard deviation of individual fingers, atd angle, (a-b)RC in right palm of deaf males and deaf females, control male and control females were 45.40, 34.98 and 47.30, 32.08 (P<0.05 and p>0.05) respectively. Not significant in females.

**Conclusion**

The dermatoglyphic patterns have been studied in several clinical conditions like diabetes mellitus, hypertension, leukemia, schizophrenia, Turner's syndrome, congenital anomalies such as cleft lip and cleft palate. In the present study palmar dermatoglyphic patterns were studied in 100 deaf cases (50 males and 50 females) and 100 controls (50 males and 50 females) using Purvis-Smith method. It was aimed to observe any statistically significant changes in palmar dermatoglyphic patterns in deaf children. The study revealed considerable decrease in mean TFRC, AFRC and mean ridge count in both male and female deaf cases. The mean atd angle in both cases was increased. The mean (a-b) ridge counts were decreased in both male and female deaf cases. Qualitative analysis revealed increase in arches and decrease in whorls of all cases. The results of this study could be of great importance to clinicians with respect to genetical basis in the identification of the cases at early stages.

**References**


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