Original Article

Study on Axial tri-radius and 'Atd' angle of Palmar Dermatoglyphics among Bangladeshi Down Syndrome People

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Abstract

Background: *Dermatoglyphics is the scientific study of the epidermal ridges and their configuration on the volar aspect of the palmar and the plantar region. There are variations of Axial tri-radius and angular tri radius ('Atd') angle among the Down syndrome people in comparison with the normal subjects. This study was designed to observe the changes of dermatoglyphics among the Down syndrome people and to compare it with the normal subjects.* ***Methods:*** *This cross sectional observational analytical study was conducted in the Department of Anatomy, Chittagong Medical College (CMC), Chattogram from January 2018 to January 2019. A total of 200 participants were included where 100 Down syndrome people were collected from different organization of Down syndrome society in Bangladesh. 100 MBBS and dental students of Chittagong Medical College both male and female were selected as control. Dermatoglyphics print was taken by the Ink & Paper method described by Cummins and Midlo. Detailed dermatoglyphic analysis was done by using magnifying glass, calculator, protractor and scale. After collection data was analysed for statistical significance by Chi-square test and unpaired t-test wherever applicable, by using a computer-based program SPSS 23 and MS Excel. The p-value was considered significant if it is <0.05 at 95% level of confidence.* ***Results:*** *The axial tri-radius at t´´ position was seen in both palms in case of 71% Down syndrome people which is most distal in position. In case of t^0 position, it was found 93% in right palm and 95% in left palm in control group that is most proximal in position. In both hand of Down syndrome people 'Atd' angle was significantly wider than healthy controls.* ***Conclusion:*** *It was revealed that there were significant differences on axial tri-radius and 'Atd' angle of palmar print pattern between Down syndrome people and healthy control. So, it can be used as a diagnostic aid for Down syndrome people.*

Key words: Dermatoglyphics, Down syndrome, Axial tri-radius, 'Atd' angle

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Introduction

Dermatoglyphics deals with the study of the epidermal ridges and their configurations on the fingers, palms and soles[1]. Dermatoglyphics patterns remain unchanged throughout the human life[1]. The epidermal ridges begin to differentiate during 12th-16th week of fetal life and completed by 20th week[2]. The skin of the palm of the hands and the plantar surface of feet is designed and corrugated with the epidermal ridges[3]. Cummin first time added the term 'dermatoglyphic' to the field of science[4]. The patterns of ridges that develop in the palm are determined genetically[5]. Any disturbance by genetic factors can produce unusual or abnormal dermatoglyphic during intrauterine life[6]. After having a good grip on the basics of dermatoglyphic, the icons of this field were inspired to search and investigate its correlation with various types of diseases like depression, schizophrenia, epilepsy, psoriasis, leprosy, Down syndrome, Klinefelter's syndrome and many other medical conditions, e.g. diabetes, hypertension, coronary artery disease, bronchial asthma, pulmonary tuberculosis, carcinoma of breast, etc.[7-9].

Down syndrome (DS) is a birth defect caused by trisomy of whole or part of chromosome 21, where individuals have 47 chromosomes in each cell instead of 46[10]. Worldwide incidence of Down syndrome is one in 1000 live births[11]. DS has high genetic complexity and phenotype variability[12-14]. Down syndrome can occur most commonly due to trisomy 21, Robertsonian translocation or mosaicism[15].

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Cummin and Midlo, classified axial tri-radii into three groups[16]. Proximal or t^0 tri-radius is normally placed tri-radius which is located at the proximal margin of the palm near the wrist joint, in the interval between thenar and hypothenar eminences[16]. Intermediate or t′ tri-radius is found half way in between the position of t^0 and t′′ tri-radii[16]. This type of axial tri-radii is found in 21% of normal population[16]. Distal or t′′ tri-radius lies near the center of the palm and usually present in 40% normal individual[16] (Figure-2). Approximately 11% of normal individual may have some combination of more than one or multiple axial tri-radii[16].

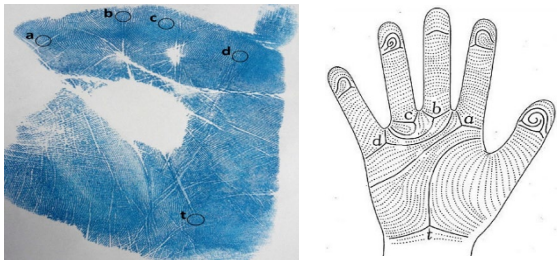


Figure-1: Diagrammatic representations of the palmar areas and palmar tri-radii[6,7]

In the palm in relation to the base of the II, III, IV and V digit, a, b, c and d tri-radius are located respectively[17] (Figure-1). Axial tri-radii or 't tri-radii' usually found in the axis of the 4th digit[17]. Cummin and Midlo in 1961 stated that axial tri-radii lies commonly near the point where the palm is connected to the wrist, in the interval between thenar and hypothenar eminences[17].

Figure-2: Photograph showing the different positions of axial tri-radii

The angular tri radius ('Atd') angle is formed by drawing lines from 'tri-radius a' to axial or 't tri-radius' and from 'tri-radius d' to axial or 't tri-radius'[17] (Figure-3). The 'Atd' angle averages about 48° among normal individuals and people with Down syndrome have an 'Atd' angle averaging 81°[17]. In adducted palm 'Atd' angle is measured usually 10° more[8,9]. The instruction for determining 'Atd' angle of the palm was given by Panrose in 1954[8,9].

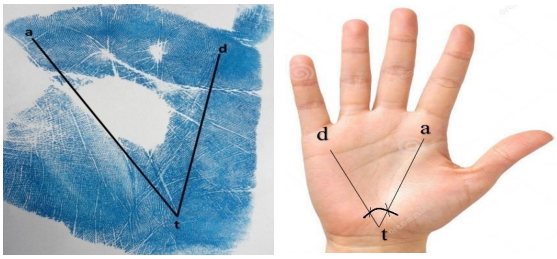


Figure-3: Photograph showing the formation of 'Atd' angle

This study was aimed to observe the changes of dermatoglyphics among the Down syndrome people and to compare it with the control subjects.

Materials & Methods

Study Design*:** This research work was a cross sectional observational analytical study. ***Study Sample*:** Total 200 sample were recruited where 100 were Down syndrome people and 100 were MBBS and Dental students of Chittagong Medical College (CMC) of both sexes as control group. Ten percent of extra Down syndrome people and students (total 110+110=220) were taken to mitigate the dropping out of the subjects. Confirmed Down syndrome people were collected from different center in Bangladesh like Down syndrome society of Bangladesh, Prerona School, Ashar Alo School, Proyas School and Society for the Welfare of the Intellectually Disabled, Bangladesh (SWID Bangladesh). Control were the Year-I MBBS and Dental students of both male and female of CMC, fulfilling the inclusion and exclusion criteria were enrolled in the study with informed consent. Basic details such as age and sex of the subject were recorded from birth certificate, national identity cards or students ID card. Dermatoglyphics print was taken by the Ink & Paper method described by Cummins and Midlo[16]. ***Sampling Method*:** Convenient purposive sampling method was adopted to select all the research participants. ***Study Period: From January 2018 to January 2019. ***Study Place*:** The department of Anatomy, CMC, Chattogram, Bangladesh.

Inclusion Criteria: Diagnosed Down syndrome people of both male and female in any age group and first year MBBS and Dental students of Chittagong Medical College were selected as research participants. All the palm print with good clear impressions were selected for further analysis.

Exclusion Criteria: Down syndrome people and control group participants with any hand deformities due to injury, birth defect or permanent scar on any of the either hand, permanent scar on their palm, worn, webbed or bandaged palms were excluded. Participants having neurological disorder e.g. seizure, multiple sclerosis, etc., signs of mental

retardation like schizophrenia, cerebral palsy were excluded from the study. Skin diseases in fingers and palm of hand e.g. fungal disease, dermatitis, eczema, psoriasis, skin rash or hypersensitivity to ink were also excluded. Those who had congenital diseases or acquired deformities of the fingers and palm of the hand other than Down syndrome e.g. congenital heart disease, Klinefelter syndrome, Turner syndrome, cleft lip, cleft palate, β Thalassemia, spina bifida (on the basis of history taking) and multifactorial diseases like diabetes mellitus, hypertension, pulmonary tuberculosis were not recruited in this study.

Measurement procedure: All research participants washed their hands with liquid soap before inking to remove dirt. Then hands were wiped with paper towel. Two white papers were fixed on clip board to take fingerprint of right and left hand. Then clip board was placed on a wooden table. The required amount of ink was poured into a clean and dry flat bottom container. Hand roller was moved in the ink until the ink was spread thinly and homogenously in the roller. Both hands were painted with the help of the roller. The thin film of ink was applied on the palm by passing the inked roller uniformly over the palm. After ensuring that palm inked properly, hand print was taken on the white paper fixed on clip board. First of all, the palmer aspect of the wrist was placed on the paper. Then slowly the palm was placed on the paper from proximal to distal end. The palm was then lifted from the paper in reverse order, from distal to proximal end. Then the individual was asked to clean both hands with turpentine oil, liquid soap under running tap water and dried with paper towel. The painted papers were examined with magnifying glass (4x & 6x). Magnifying glass was used to zoom in the palm prints and determination of different dermatoglyphics pattern. In this study dermatoglyphics pattern were recorded separately for axial tri-radius and 'Atd' angle in palmar area of both hands in data sheet (Figure-2 & 3).

Statistical Analysis: After collection, data was analyzed for statistical significance by Chi-square test and unpaired t-test by using a computer-based program SPSS-23 and MS Excel. P value was considered significant if it was <0.05 at 95% level of confidence.

Ethical Approval: The protocol of this study was approved by the members of the Ethical Review Board (ERB) of Chittagong Medical College, Chattogram and received a certificate of ethical clearance of ERB.

Results

Comparison of position of axial tri-radii

Table-I showed that on the right palm the axial tri-radius was at t^0 position in 93% of the control group and 7% of the Down syndrome group (p<0.001). Only 7% of them had at intermediate t′ position of the control group and 22% of the Down syndrome group in right palm. On the left palm the axial tri-radius was at the basal t^0 position in 95% of the control group and in 10% of Down syndrome people (p<0.001). Only, 5% of them had at intermediate t′ position of the control group and 19% of the Down syndrome group in right palm. The axial tri-radius at distal t′′ position was absent in both palms of the control group but it was seen in 71% in both palms of Down syndrome people (p<0.001).

In both palms, the position of axial tri-radius at t′′ position was absent in control groups and majority (94%) of them had at proximally t^0 position (Figure-4). Only, 6% of them had at intermediate t′ position. In contrast, the prominent position was at t′′ position in 71%, followed by t′ in 20.5% and t^0 in 8.5% of Down syndrome people. These differences were highly significant (p<0.001).

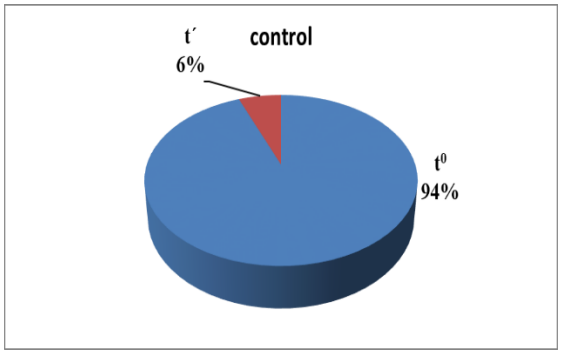
Comparison of 'Atd' angle

'Atd' angle was distributed and compared according to their mean. The mean±SD of 'Atd' angle values for Down syndrome people in right hand was 76.0±15.5 and in left hand was 74.7±16.1. The mean±SD of 'Atd' angle values for control are distributed in table-II and figure-6. In both hand of Down syndrome people 'Atd' angle was wider than control mean and the difference was statistically highly significant in case of both hands (p<0.001).

Table-I: Comparison of percentage of frequencies of axial tri-radii between Down syndrome people and control (n=200)

Palm	Patterns of axial tri-radii	Group		p value
		Down syndrome (n=100)	Control (n=100)	
Right palm	t^0 t′ t′′	7 (7%) 22 (22%) 71 (71%)	93 (93%) 7 (7%) 0 (0%)	<0.001**
Left palm	t^0 t′ t′′	10 (10%) 19 (19%) 71 (71%)	95 (95%) 5 (5%) 0 (0%)	<0.001**

Statistical analysis done by Chi square test, ** = statistically significant test (p<0.001).



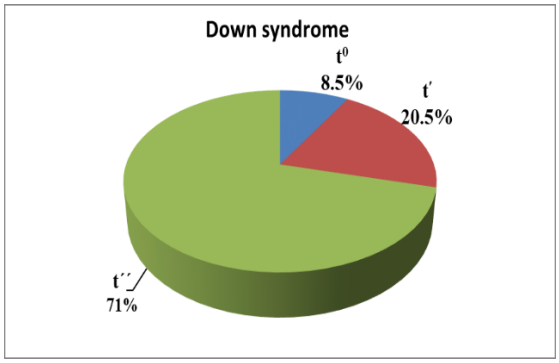
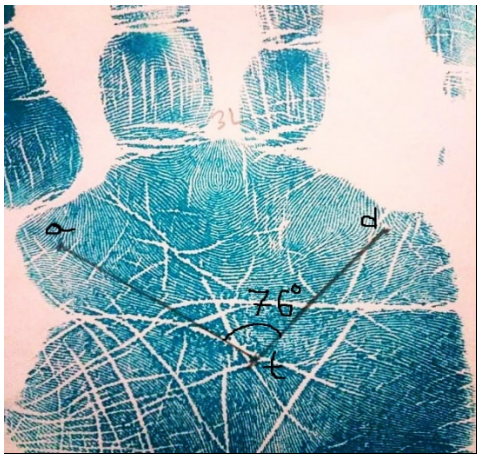
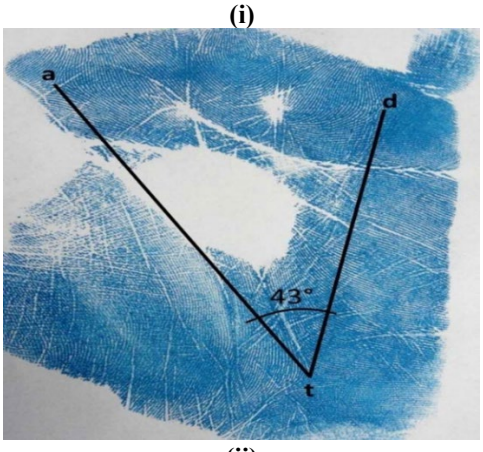


Figure-4: Pie charts showing distribution of axial tri-radii in both hands in Down syndrome and control



(i)



(ii)

Figure-5: Comparison of 'Atd' angle, (i) Down syndrome and (ii) Control

Table-II: Comparison of both hands 'Atd' angle between Down syndrome & control (n=200)

Hand	Degree of Atd angle Mean±SD		P value
	Down syndrome (n=100)	Control (n=100)	
Right hand	76.0±15.5	41.2±3.9	<0.001**
Left hand	74.7±16.1	41.2±3.7	<0.001**

Statistical analysis done by unpaired t-test,
**=statistically significant test (p<0.001).

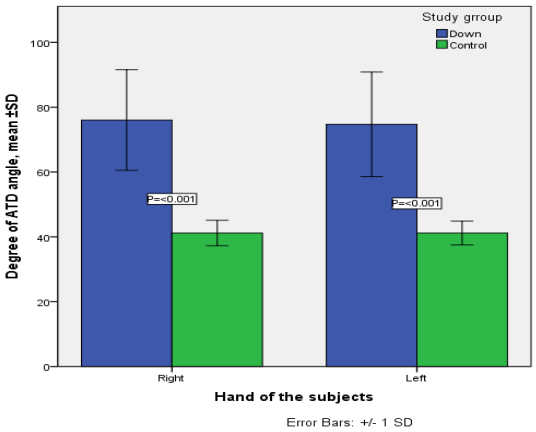


Figure-6: Distribution of 'Atd' angle of right and left hand in Down syndrome and control

Discussion

In the present study, the axial tri-radius on the right and left palm was found at t^0 position among the control group. The axial tri-radius at distal t´´ position was absent in both palms of the control group but which was seen in both palms of Down syndrome people. Shiono observed 43.5% axial tri-radius was at t´´ position in the left palm and 44.8% in the right palm of Down syndrome people, while in the control group the percentage of frequencies were 4.2% and 4.0% respectively[18]. Ţarcă also observed that, pathological sign of distal and solitary shifting of the axial tri-radius t in intermediate t´ position and distal t´´ position was very high in case of Down syndrome people and in higher percentage on the left hands instead of the right ones, as in normal people[19]. Frequencies of distal axial tri-radius of Malay people with Down syndrome was more in left hand than right hand[20]. Frequencies of distal axial tri-radius of 200 Malay control was significantly less both in right and left hand when comparing with the Down syndrome people which was also consistent with the present study[20]. Walker found the frequencies of distal axial tri-radius of white 161 patients with Down syndrome was 84.4% in right hand and 85.8% in left hand[21]. Frequencies of distal axial tri-radius among

255 control was 13.3% in right and 10.2% in left palm was also found in their study[21]. When comparing the two group, Walker revealed that the frequencies of distal axial tri-radius was more among the Down syndrome people than control group which finding was similar to the present study.

In both hands, the position of axial tri-radius distally (t′′) is more prominent in Down syndrome people while in control group the position of axial tri-radius at t′′ position was absent. In control group majority of them had t^0 position at proximally. Only, 6% of them had at intermediate t′ position. Frequencies of distal axial tri-radius t′′ in both palm of Malay people with Down syndrome was 82.5% and control was 0.5% and the differences were highly significant and correlate to present study[20]. Walker found the frequencies of distal axial tri-radius t′′ of Down syndrome people was 85.1% and control was 11.8% in both palm[21]. Saksena reported a high axial tri-radius in all the Down syndrome cases in both hand[22]. Another researcher found axial tri-radius t′′ 76.6% in Down syndrome people and 3.2% in normal persons, whereas frequency of t^0 was 11% in Down syndrome people and 77.2% in normal individuals in both palm[23]. The frequencies of palmar distal axial tri-radius in both hand among Chinese Down syndrome people was more than control group which was also similar to the present study[24]. A high axial tri-radius t′′ was found in case of both palm which was 83.2% among Down syndrome people and 8.5% in control by an investigator[25].

The present study showed that, the mean±SD of 'Atd' angle values for Down syndrome people in right hand was 76.0±15.5 and in left hand was 74.7±16.1. In case of both hands, Down syndrome people had a significantly wider 'Atd' angle than controls ($p<0.001$). The very high position of tri-radius t′′ on the palm, either single or in a combination with other positions, were also responsible for increasing 'Atd' angle. Similar to our findings, quantitative analysis of 'Atd' angle of Down syndrome people in right and left hand showed wider angle in a study[23]. For Down syndrome cases, the 'Atd' angle was toward higher side (t′′>57°), whereas in normal persons angles were of lower range (t^0<45°) in their study and the findings were consistent with our study[23]. Ţarcă in 2001 observed a high frequency of increased 'Atd' angle in both male and female Down syndrome people which was supposed to amplify its mal-formative effect[19]. Wider 'Atd' angle in 60.2% of Down syndrome people had been reported from South India also[26]. Malla measured 'Atd' angle and compared it with the normal values. In their study, they found 18 cases had wider 'Atd' angle out of 21 and in right hand which was 51.53° [27]. Another investigator found percentage of frequencies of maximal 'Atd' angle in Down syndrome people in right & left palm which was 52% and 55% respectively in contrast to control[28].

Limitation of the study

The comparatively shorter period of time for conducting this cross-sectional study and smaller sample size might not represent the whole community. Socio-demographic factors were not assessed in this study.

Recommendations

As the present study was conducted in a limited territory, further large-scale study is recommended. This study was the first such observation and record in this area and can be used as the basic data which is useful for future research, biometric analysis and multi-disciplinary studies. In future studies computerized automatic palmar print reading system should be used to collect dermatoglyphics.

Conclusion

From the result it was revealed that there were significant differences in palmar print pattern between Down syndrome people and control. The axial tri-radius at t′′ position was seen in 71% in both palms of Down syndrome people that was most distal position and t^0 in both palms of the control group that was most proximal in position. In both hand of Down syndrome people, 'Atd' angle was significantly wider than control group.

Conflict of Interest

The authors report no conflict of interest.

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