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Original Research Article

Role of Palmar Angles in Screening Down's Syndrome in Nigeria

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Abstract

On the palm are seen several angles known as 'ATD' angle, 'DAT' angle and 'ADT' angle. These angles are very useful medically. The aim of this study was to determining the palmar angles of down's syndrome subjects in Nigeria. The study recruited 201 subjects, 101 Down syndrome subjects and 100 control subjects. The subjects were selected using a convenience sampling method from special and inclusive schools in Nigeria. Autocad program was used to measure the angles with high reliability. Data were collected and analysed using Mann Whitney U test. The results showed that Down syndrome had significantly higher ATD angle and significantly lower DAT and ADT angles when compared to control subjects. In conclusion, the result implies that Down syndrome showed high correlation with ATD, DAT ADT angles. These angles should serve an adjunct diagnostic tool for early screening and intervention of Down syndrome patients in Nigeria.

Keywords: ATD angle, DAT angle, ADT angle, Screening, Dermtgolyphics.

INTRODUCTION

Dermatoglyphics is the study of the epidermal ridges of the skin located on the surface of the fingers, palms of the hands and soles of the feet (Cummins and Midlo, 1943). The epidermal ridges on these surfaces are thicker, hair free, has sweat gland and aid contact (Kumbnani, 2007). The understanding of dermtoglyphics aids in the understanding of some questions in biology, medicine, genetics and evolution, and provides solution to most of those questions (Pratibha *et al.,* 2011; Oladipo *et al.,* 2013). The brain and skin develop from the same ectoderm. At about 13th week of intrauterine life dermal ridges begin to form and complete its formation at about the 21st week of intrauterine life. At this period of development, various organs also develop alongside, especially neuronal development, so that ridge pattern can be affected by certain abnormalities of early development. It is on this ground that dermatoglyphics is correlated with genetic abnormalities, mental illnesses and chromosomal disorders such as down syndrome, autism, diabetes, schizophrenia, etc. (Walker, 1977; Lainhart*et al.,* 1997; Bulagouda *et al.,* 2013; Singh *et al.,* 2016a,b).

On the palm are also seen some angles known as 'ATD' angle, 'DAT' angle and 'ADT' angle. These angles are very useful for medical purposes especially ATD angle. ATD angle is formed by drawing lines from the digital tri-radius 'a' to axial tri-radius 't' and then the digital tri-radius 'd'. The more distal the position of 't' triradius the larger the ATD angle (Pratibha *et al.,* 2011). ATD angle is actually a displacement of the axial 't' triradius on the palm. Sometimes two or more axial triradii may be seen on the palm. When it occurs near the centre of the palm it is called t", and when it is seen between t" and t, it is called t'. ATD angle depends on the position of the axial triradius and it is a useful measurement to quantify the position of the most distal axial triradius (Verbov, 1970). It is accepted that the smaller the value of ATD angle the higher the level of intelligence. ATD angle ranged between 38^{o} – 55^{o} with 48^{o} average among normal individuals and average 81^{o} among Down's syndrome individuals (Fogle, 1990).

Down's syndrome (DS) is a chromosomal condition that is caused by the presence of all or part of a third copy of chromosome twenty-one (21) and so it is also called trisomy 21, (Gordon, 2010; Butter and Meaney, 2005). It is typically associated with a delay in cognition ability (mental retardation) and physical growth with a particular set of facial characteristics. A large number of individuals with Down's syndrome have a severe degree of intellectual disability. Individual with Down's syndrome have some certain physical and

mental disorder traits which are caused by the gene responsible for the condition before a baby is born.

There are also some dermatoglyphic characteristics that are prominent in Down's syndrome patients. A Down's syndrome patient has only one palmer transverse crease known as simian crease and sometimes Sydney line, higher number of ulnar loop dermatoglyphics especially on digit I-III and V and short fingers, a single flexion furrow of the fifth finger, etc.

Though a lot of works have been done for ATD angle of Down's syndrome alone and higher ATD angle is associated with Down's syndrome, however not much is done on other angles on the palm like ADT and DAT angles. Hence the study seeks to determine the role of palmer angles of Down's syndrome subjects in Nigeria to see if it could also serve as tool for screening Down's syndrome and bring about early intervention.

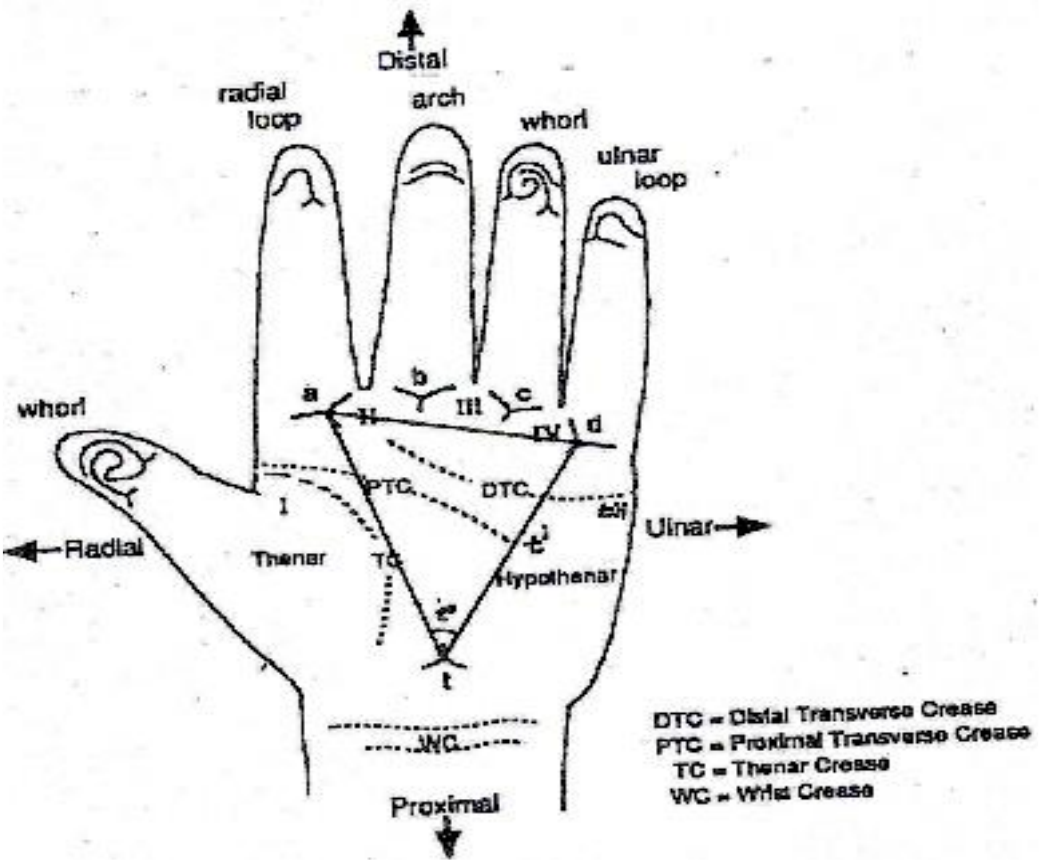

Figure 1: Palmar angles (source: Oladipo *et al.*, 2013)

METHODOLOGY

The study employed a descriptive sample survey method, carried out in some selected cities in Nigeria such as Lagos, Abuja and Port Harcourt. This study comprised both male and female Down's syndrome subjects in Nigeria ranging between ages of 5 to 35 years of age. The minimum sample size was 101(58 males and 43 females) for Down's syndrome, Control subjects used was 100 (65 males and 35 females). A convenience sampling technique was used to collect data. This is as a result of the difficulty in getting the children due to fear of stigmatization. The subjects who met the inclusion criteria were selected from various special schools within the study area. Information needed for the selection of the subjects was obtained directly from the occupational therapists, care-givers or teachers which were supported by the physical observations of the researcher. An informed consent containing details of the research work was issued out and clarifications given were necessary before the commencement of work.

The dermatoglyphic patterns were collected and determined using the scanning method according to Oghenemavwe & Osaat (2015). The subjects' fingers and palms were thoroughly washed with water and soap and dried with clean towel to remove dirt. The subject was asked or assisted to place the washed palms on the scanner and accordingly the palms were scanned. The scanned images were saved in a folder. Later on, collation of raw data was obtained from the scan images and used for further analysis. Angles were measured using AUTOCAD Program. The program automatically measured the angles after a line drawn between two tri-radii. The Autocad helps minimize errors and increases the reliability of the study.

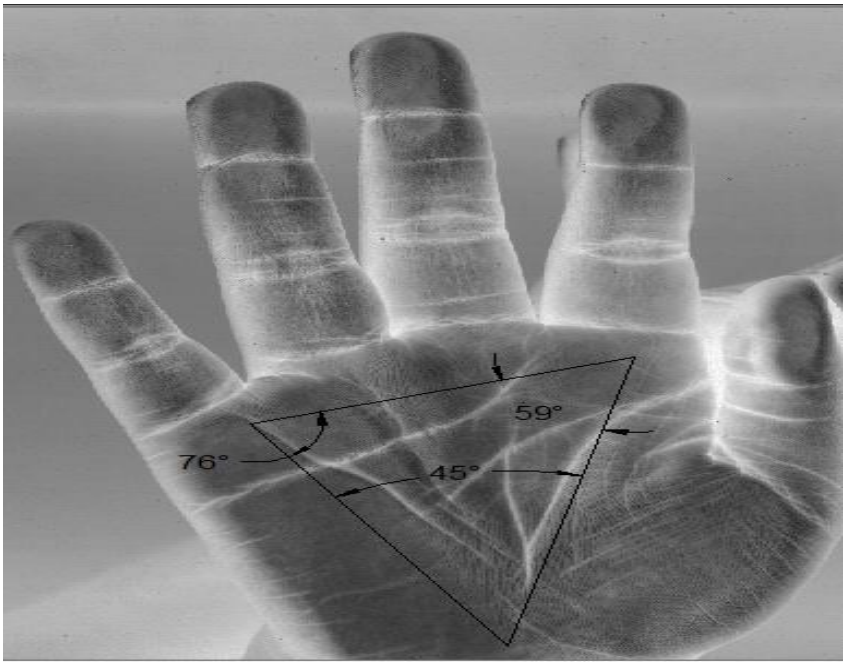

Figure 2: Autocad software used to measure angles

The Data obtained from this study were subjected to test using SPSS (Statistical Package for Social Science IBM ® Version 23 New York). Mann-Whitney U test was used to analyse the results. All statistical testing was done at 95% confidence level with p-value less than 0.05($p< 0.05$) taken to be significant.

Prior to commencement of the research work, ethical approval was sought from the Research Ethics Committee of the School of Graduate Studies, University of Port Harcourt in form of proposal writing and it was approved with reference number UPH/CEREMAD/REC/04. In addition, informed consent was obtained from the parents/guidance and institutional authorities of the subject by signing a consent form given to them before samples of the subjects under study were taken.

RESULTS AND ANALYSIS

Table 1 showed Mann-Whitney U test was used to test for differences between palmar angles (ATD, DAT and ADT angles) of Down's syndrome subjects and normal subjects on the right and left hands of both sexes. The result showed that ATD angle was significantly increased in Down's syndrome subjects as compared to control subjects on the right hand, while DAT and ADT angles were significantly decreased in Down's syndrome subjects as compared with normal subjects ($p<0.05$). On the left, same result was observed. Table 2 showed that ATD angle was significantly increased in male Down's syndrome subjects as compared with male control subjects on the right hand, while DAT and ADT angles were significantly decreased in Down's syndrome subjects as compared with control subjects ($p<0.05$). On the left, same result was observed except ADT angle was not significant ($p>0.05$). As shown in table 3, ATD angle was significantly increased in female Down's syndrome subjects as compared to female control subjects on the right hand, while DAT and ADT angles were significantly decreased in Down's syndrome subjects as compared with control subjects ($p<0.05$). On the left, same result was observed except ADT angle was not significant ($p>0.05$).

Table 1: Mann-Whitney U test comparing the right and left dermal angles of Down's syndrome and normal Subjects of both sexes

Right dermal angles	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	P-value
ATD	DS Subjects	101	118.93	12012.00	3239.00	8289.00	-4.40	0.00**
	NO Subjects	100	82.89	8289.00				
DAT	DS Subjects	101	87.31	8818.50	3667.50	8818.50	-3.36	0.00**
	NO Subjects	100	114.83	11482.50				
ADT	DS Subjects	101	82.70	8353.00	3202.00	8353.00	-4.49	0.00**
	NO Subjects	100	119.48	11948.00				
Left dermal angles								
ATD	DS Subjects	101	117.87	11904.50	3346.50	8396.50	-4.14	0.00**
	NO Subjects	100	83.97	8396.50				

Right dermal angles	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	P-value
DAT	DS Subjects	101	83.50	8433.50	3282.50	8433.50	-4.29	0.00**
	NO Subjects	100	118.68	11867.50				
ADT	DS Subjects	101	90.64	9155.00	4004.00	9155.00	-2.54	0.01**
	NO Subjects	100	111.46	11146.00				

Note ** - significant, DS – Down's syndrome, z- z score

Table 2: Distribution of the right and left Dermal angles and test of association in males of Down's syndrome and normal subjects

Right Dermal Angles	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	P-value
ATD	DS Finger	58	71.83	4166.00	1315.00	3460.00	-2.89	0.00**
	Normal Finger	65	53.23	3460.00				
DAT	DS Finger	58	53.53	3104.50	1393.50	3104.50	-2.49	0.01**
	Normal Finger	65	69.56	4521.50				
ADT	DS Finger	58	51.21	2970.00	1259.00	2970.00	-3.18	0.00**
	Normal Finger	65	71.63	4656.00				
Left dermal angles								
ATD	DS Finger	58	69.18	4012.50	1468.50	3613.50	-2.11	0.03**
	Normal Finger	65	55.59	3613.50				
DAT	DS Finger	58	54.10	3138.00	1427.00	3138.00	-2.32	0.02**
	Normal Finger	65	69.05	4488.00				
ADT	DS Finger	58	55.21	3202.00	1491.00	3202.00	-2.00	0.05
	Normal Finger	65	68.06	4424.00				

Note ** - significant, DS – Down's syndrome, z- z score

Table 3: Distribution of the right and left dermal angles and test of association in females of Down's syndrome and normal subjects

Right Dermal Angles	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	P-value
ATD	DS Finger	43	46.86	2015.00	436.00	1066.00	-3.18	0.00**
	Normal Finger	35	30.46	1066.00				
DAT	DS Finger	43	34.20	1470.50	524.50	1470.50	-2.29	0.02**
	Normal Finger	35	46.01	1610.50				
ADT	DS Finger	43	32.56	1400.00	454.00	1400.00	-3.01	0.00**
	Normal Finger	35	48.03	1681.00				
Left dermal angles								
ATD	DS Finger	43	48.16	2071.00	380.00	1010.00	-3.75	0.00**
	Normal Finger	35	28.86	1010.00				
DAT	DS Finger	43	30.73	1321.50	375.50	1321.50	-3.79	0.00**
	Normal Finger	35	50.27	1759.50				
ADT	DS Finger	43	36.19	1556.00	610.00	1556.00	-1.43	0.15
	Normal Finger	35	43.57	1525.00				

Note ** - significant, DS – Down's syndrome, z- z score

DISCUSSION OF RESULTS

ATD angle have been studied by several researchers as a possible marker of genetic disorders like Down syndrome. Dermal angles have been found to be very useful especially for medical purposes. A wide angle is always seen in malformations (disorders) like Down's syndrome. This is in line with the present study where Down's syndrome was observed to have a higher or wider ATD angle when compared to normal subjects, this could be due to the high positioning of the distal axial triradius which result from the present of either hypothenar loops and/or whorls in the hypothenar area (Tarca, 2001). Sariza *et al.* (2021) conducted cross sectional study on the Dermatoglyphics Findings in Intellectual Disability Children with Down Syndrome, Autism Spectrum Disorder and Attention-Deficit Hyperactivity Disorder, and found out that the angles of ATD Down syndrome, ASD and ADHD are in the average person's value ranged between 30°–65°. Accordingly, the majority of intellectual disability individuals with these three conditions shared relatively the same dermatoglyphic findings yet also show differences in some measurements, implying varied pathways. From the present study the dermal angles

(ATD, DAT and ADT) between Down's syndrome and normal subjects was observed to be statistically significant, with Down's syndrome having a significantly higher ATD angle and decreased DAT and ADT angles. This finding was in line with the study of Mensvoort (2009) and Fogle (1990). A situation where 't' triradius is not available implying that the ATD angle cannot be measured, the other palmar angles – DAT and ADT can serve the same purpose. According to Nagla *et al.* (2013) children with lymphoblastic leukemia had significantly lower ATD, tad and abridge with no significant difference as regards ADT angle than control group as regards the right-hand measurements. On the other hand, the patient's group had significantly lower ATD, ADT angles and ab-ridge count and significantly greater tad angle than the control group as regards the left-hand measurements. The result is similar to the present study.

The male Down's syndrome subjects have high ATD angle than male control, and female Down's syndrome have high ATD angle than female control. Sexual dimorphism was observed bilaterally. In contrast to the finding on Down's syndrome, Ozyurt *et al.* (2010) observed that the male schizophrenia have a significantly lower ATD angle especially on the left hand compared to the male control. The right hand was also significant. Oladipo *et al.* (2007b) also reported a lower ATD angle for sickle cell anaemia when compared to their controls. Wakhisi *et al.* (2023) observed that mean ATD angle between non-diabetics and diabetics was 43.97º and 43.15º respectively but difference was not statistically significant (p=0.0998). For Down's syndrome, ATD angle is a strong dermatoglyphic indication, indicating strong genetic influence. DAT and ADT angles also play important role though much work have not focused on them. In the present study, ADT angle was observed to be significantly lower in Down's syndrome than controls, the decrease could be as a result of the very high position of triradius 't' on the palm and as well as the large ATD angle observed in Down's syndrome subjects. The male subjects have higher dermal angles than the female subjects. According to Wakhisi *et al.* (2023) there was no statistical difference in ATD measurements among both males and females of diabetics and non-diabetics groups. Sexual dimorphism observed. The sex differences observed in this study suggest that males have greater prenatal susceptibility to neurodevelopment instability and they tend to be more environmental sensitive than the female because their prenatal growth is more affected by stress (Murray, 1991; Arrieta *et al.,* 1992; Bogle and Reed, 1997; Reilly *et al.,* 2001).

From the result of this study, it was deduced that Down's syndrome is actually influenced by genetic as well as environmental factors which Villar and Epstein (2005) believed to be the etiology of trisomy 21. However, dermatoglyphic features especially ATD, DAT ADT angles should serve an adjunct diagnostic tool owing to its wide variations.

CONCLUSION

From the present study, ATD angle was observed to be significantly higher for Down syndrome subjects while DAT and ADT angles were observed to be significantly lower for Down syndrome subjects when compared to control subjects. This implies strong genetic and environmental influences on Down syndrome and that dermatoglyphic traits especially ATD, DAT, ADT angles should serve an adjunct diagnostic tool for early screening and intervention of Down syndrome patients in Nigeria.

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