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Quantitative and Qualitative Study of Dermatoglyphic Patterns in Albinism

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Abstract: The changes of dermal ridges in albinism patients were studied. The results obtained from subjects with albinism were compared with healthy subjects. A number of 30 patients were finally selected as our sample sizes. To gain a better understanding the results, a case-control study with the similar number of cases and control was designed. The related statistical test, t-test and chi-square, were considered to evaluate whether the discrepancy is statistically significant. The results indicated that a-b ridge counts of the right side were decreased significantly ($p = 0.04$). Moreover, the discrepancy between cases and controls for the case total a-b ridge count (TABRC) was statistically significant ($p = 0.06$) at 10% significant level. Furthermore, based on the visual analysis, there was no strong evidence for the differences between cases and controls from the fingerprint shapes point of view. The general result is that dermatoglyphic can be considered as a valuable aid and promising method for genetic analysis and albinism studies.

Keywords: Albinism, dermatoglyphic, Persian race, TABRC

INTRODUCTION

Nowadays, a noticeable understanding of dermatoglyphics has been achieved (Connie *et al*., 2005). The analysis of dermal ridges is used for diagnosis of some important diseases (Baca *et al*., 2001). Skins of the human fingers, palm and sole have some ridges, which create special forms. Dermatoglyphic pattern configurations are completed after the sixth prenatal month and will no longer change (Yunyu *et al*., 2002). During this crucial period dermal ridges may form in some abnormal patterns, thus they can be used in etiology of diseases (Fearon *et al*., 2001) Investigators have carried out scientific projects concerning to dermatoglyphics. The previous researches confirm that there is a relation between dermatoglyphics and some diseases, such as schizophrenia, Down's syndrome, Alzeihmer, Multiple Sclerosis, congenital spinal cord anomalies (Rezaei Nejhad and Mahdavi Shahri, 2010).

Many dermatoglyphic characteristics can be described quantitatively. These characteristics usually include count ridges between two specific triradiis. The most frequently obtained ridge count is between triradii a and b which is known as the a-b ridge count. Moreover, b-c and c-d lines and Atd Angles (ATDA) are the other indices that are considered as other characteristics. Figure 1 illustrates the above positions.

Various research studies indicate that qualitative characteristic can lead us to achieve a better result (Holt, 1986; Supe *et al*., 1997). Figure 2 shows the shapes of fingerprints.

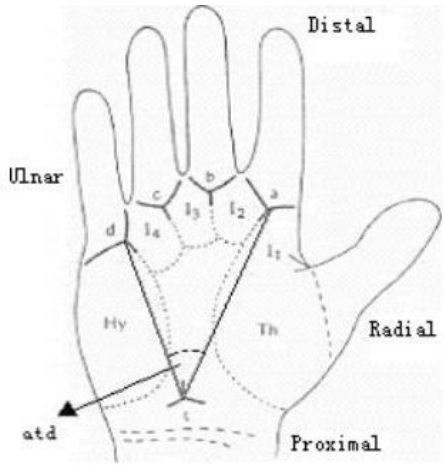

Fig. 1: The diagram of a palm with dermatoglyphic pattern areas

It has been shown that patients with choromomal anomalies have the uncommon dermal ridges pattern. Thus, biometric feature based on palm print and fingerprints were focused on the genetic diseases and have made enormously progress (Shamsuddini and Muhammad Abadi, 1981). Note that genetic abnormalities of the melanin pigment system, in which the synthesis of melanin is reduced or absent, are called albinism.

The reduction in melanin synthesis involves the skin, hair follicle and eye, resulting in oculocutaneous albinism, or can be localized primarily to the eye, resulting in ocular albinism. Approximately, one in 17,000 individuals in

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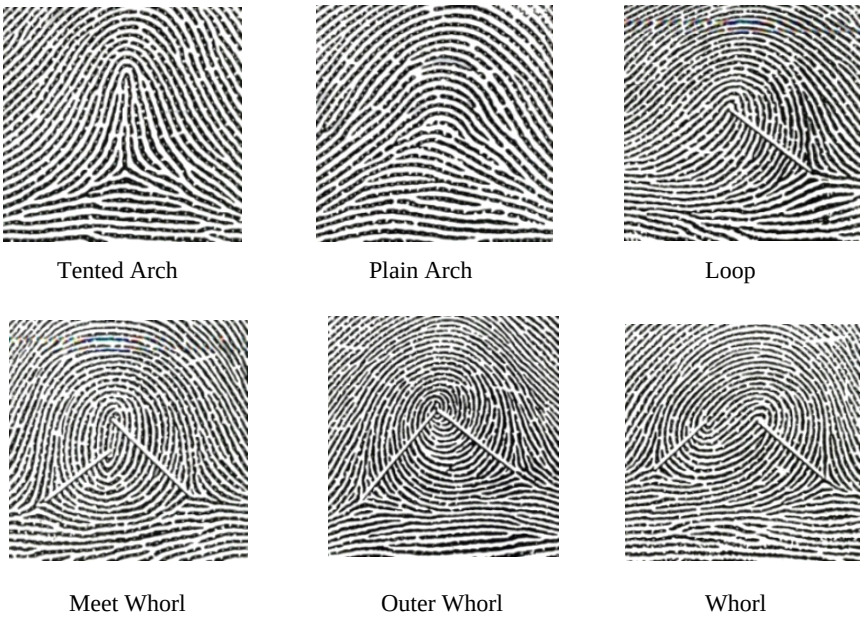

Fig. 2: The shapes of fingerprints

the United States has oculocutaneous albinism and more than 1% of the population are heterozygous for a gene producing albinism (King and Summers, 1998). The lack of melanin pigment in the developing eye leads to fovea hypoplasia and abnormal routing of the optic nerves. These changes are responsible for the nystagmus, strabismus and reduces visual acuity common to all types of albinism. Mutations in six genes have been reported to be responsible for different types of oculocutaneous and ocular albinism, including the Tyrosinase gene (TYR) and OCA1, the OCA2 gene, the Tyrosinase-Related Protein-1 gene (TYRP1) and OCA3, the HPS gene and Hermansky-Pudlak syndrome, the CHS gene (CHS1) and Chediak-Higashi syndrome and the X-linked ocular albinism gene and OA1 (William and King, 1999). The function of only two of the gene products is known as tyrosinase and tyrosinase-related protein-1 both of which are enzymes in the melanin biosynthetic pathway (Boissy *et al*., 1996).

MATERIALS AND METHODS

In this research, the study group was taken from Persian race that had the desire characteristic and their illness has been approved by the physician. The case and control samples have been collected from different parts of Iran in 2011. The control group was taken from healthy subject. The study was carried out on 30 albinism patients and the control group was made up clinically healthy 30 subjects. The technical principles are precisely observed in Dermical ridges' registration in all administration processes. We used the Dermical ridges' registration with ink method. To this end, after soaking the terminal

Fig. 3: The picture of a right hand patient

phalanxes with ink, clear banderoles were attached and then were transferred to a paper. The fingerprint remains on the paper clearly and visibly using this approach.

Due to preparing hand-palm ridges, hand palm was soaked with ink and then by use of a rotating hollow cylinder with paper placed on. The hand was located on it from tip of the finger and was slowly moved ahead in order to hand-palm ridges, printing occurred on the paper.

The trirdaii of a, b and c were located under each finger. After detecting them, their centers were connected together and through stereomicroscope the ridges between these trirdaii were counted. For avoiding visualization error, we first applied the procedure using the information of two samples. The results were then compared to

evaluate the accuracy of our approach. The total ridge counting of a-b (TABRC) includes the sum of ridge counting of a-b in left and right hand. The type of each fingerprint for every subject was determined. The finalized data sets were then analyzed using suitable statistical methods. Figure 3 illustrates an example of the extracted pattern for a right hand patient.

RESULTS AND DISCUSSION

Let us now evaluate the obtained results from different perspectives. The study reveals noticeable results:

- Quantitatively, there is the smaller number of right a-b ridges in the case group in comparison with the control group.
- Qualitatively, the distribution of all types of fingerprints was homogeneous and not meaningful.

Table 1 represents the number, N and the corresponding relative frequency, RF, of fingerprint types in whorls, Loops and arch in both groups. A can clearly be seen the numbers are very close. For the test group, 56.33, 41.33 and 2.33% of the total data were distributed in Loops, Whorls and Archs finger print categories, respectively. Similarly, 53.66, 42.66 and 3.66% are distributed for the control group respectively.

Table 2 also represents the descriptive statistics of our data sets. The last column represents P-value. As it appears from the results, there is a statistically significant difference (at 5% level) for row a-b R. However, if we increase the significant level to 10% the discrepancy between case and control considering TABRC is significant. All results are obtained by R software. It should be noted that as the data are not distributed normally and not continues data. Thus, we used nonparametric T-test.

Different studies on dermal ridges in various diseases have shown that the ridges are in a special pattern in some diseases. Especially, patients with choromomal anomalies have the uncommon fingerprints. Some of the most important dermatoglyphic characteristics of patients in bipolar disorder have reported in recent years. (Mahdavi Shahri *et al*., 2006). The result signifies the congenital abnormalities of dermal ridges in these individuals (Jelovac *et al*., 1998).

Congenital infections such as the one caused by Rubella virus and taking some special materials by mother's body during the pregnancy, e.g., alcohol and some drugs all have the potential for altering dermal ridges' patterns during the fatal period. These factors and genetic background between the second and fifth month of pregnancy may cause abnormal deramtoglyphics (Cisark *et al*., 1985; Fananas *et al*., 1996; Purvis-smith and Menser, 1986; Tillner and Majeweski, 1978).

Bogle *et al*. (1994), proposed that a-b ridges change according to environmental factors and tensions since the development of spaces in hand-palm area begin sooner than ridges and patterns of hand tips and finish later (Bogle *et al*., 1994). In relation to the tip of fingers patterns (qualitative feature) no comprehensive study has been conducted in other countries.

At present, a lot of work on palm print is done manually and the degree of automation is low. This makes computation complex, inaccurate and slow. Computation of most statistics on palm prints still employs ordinary methods such as percentage, mean average, standard deviation, t distributed test and chi square test. Many up to date methods such as multi-variate analysis and cluster analysis have been rarely used (Yunyu *et al*., 2002).

At the time of studying dermal ridges, a couple of characteristics have to be used that are not the same as other illnesses. For instance, decreasing of arch forms and increasing of loop forms in persons suffering from schizophrenia and diabetes dependent to insulin have been observed (Ramezani *et al*., 2005). Thus, for precise determination of illness type, we need to perform other characteristics such as determining the ATD angle, ridge

Table 1: Frequency distribution of fingerprints types in all the subjects of both test and control groups

	Test group		Control group	
Fingerprints type	RF	N	RF	N
Loops	56.33	169	53.66	161
Whorls	41.33	124	42.66	128
Archs	2.33	7	3.66	11

Table 2: Descriptive statistics of the data

	Mean		Median		Range		Variance		
	Case	Control	Case	Control	Case	Control	Case	Control	p-value
L	5.63	5.36	6	6	10	9	9.75	7.5	0.69
W	4.13	4.26	4	3	10	10	10.74	9.02	0.86
A	0.21	0.37	0	0	2	5	0.23	0.99	0.70
a-b R	34.3	37.3	34	37	24	24	33.94	22.43	0.04**
a-b L	35.8	37.7	35	37	26	26	27.15	33.87	0.20
TABRC	70.0	75.03	68.5	73.5	50	48	110.65	98.10	0.06*

*: significance level at 10%; **: significance level at 5%

counting of a tip of fingers and ridge counting of a-b, c-d ridges of hand.

RECOMMENDATIONS

According to the results obtained from our sample and surveys, the researchers recommend that to complement knowledge on the subject matter. The following recommendations are suggested.

First, increasing the number of sample size to cover the population target better. This also increases the accuracy of the statistical results. Another suggestion is that designing a quantitative and qualitative research to cover the other features such as dermatoglyphic, e.g., count of dermal ridges in fingerprints. Furthermore, studying on sweat glands pores in patients's palm prints and comparing them with normal people can be considered as another recommendation and future research plan. In general, the results obtained from this research open a new insight for further studies from different point of view in futures.

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