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Original Research Article

Exploring Fluctuation Asymmetry in Dermatoglyphic Patterns as Potential Indicators of Breast Carcinoma: A Comparative Analysis

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Abstract

Background: Carcinoma breast is one of the most widespread forms of cancer affecting women worldwide. Numerous screening tools have been devised. One such tool on which extensive studies have been conducted is dermatoglyphics.

Materials and Methods: In the present study, 100 cancer patients and 100 controls were studied and their finger and palm prints were taken using roller-ink method. Different parameters like radial and ulnar loop, whorls, arches, total finger ridge count (TFRC), absolute finger ridge count (AFRC), a-b ridge count, palmar angles (<atd, <tda and <dat) were studied. Their fluctuation asymmetry was studied in cancer patients as well as controls.

Results: Fluctuation asymmetry was seen in index, finger, middle finger and little finger of cancer patients. At the same time TFRC, AFRC, and palmar angle <tda and <dat in cancer patients showed fluctuation asymmetry.

Conclusion: Fluctuation asymmetry in dermatoglyphics can be used as an effective screening tool in high-risk cases as well as early treatment can be started which will be beneficial to the patient and society as a whole.

Keywords: Carcinoma Breast, Dermatoglyphics, Fluctuation Asymmetry.

Introduction

Carcinoma of mammary glands is one of the most widespread forms of cancer affecting women worldwide. It is now leading cause of global cancer incidence in 2020, with an estimated 2.3 million new cases, representing 11.7% of all cancer cases [1]. In India the approximated percentage for breast cancer for age up to 65 years is 23% till year 2022 [2]. The early detection and accurate diagnosis of breast carcinoma are crucial for effective treatment and improved patient outcomes.

While various diagnostic methods and biomarkers have been studied in relation to breast cancer, there is ongoing research exploring alternative indicators that may aid in early detection and risk assessment. Dermatoglyphics is the study of finger, palm and sole prints. It is the potential technique for investigating subtle biological variations and their associations with different diseases and conditions [3]. Fluctuation asymmetry as the name itself defines, random deviations from perfect symmetry in bilateral structures. It is a potential marker of developmental instability and underlying genetic factors [4]. There has been inquisitiveness amongst the researchers to find out the relation between the fluctuation asymmetry in dermatoglyphic patterns of carcinoma breast patients. The rationale behind this research was based on the understanding that genetic and environmental factors may influence the development of carcinoma breast and dermatoglyphic patterns, resulting in asymmetry which can be detected [5].

Knowledge on early detection and risk assessment by exploring a novel avenue through dermatoglyphics and fluctuation asymmetry analysis may have implications for early detection methods and personalised screening approaches, ultimately improving patient outcomes and survival rates. So, the present study was planned with objectives to explore the presence of fluctuation asymmetry in dermatoglyphic patterns and its potential correlation with breast cancer.

Materials and Methods

This cross-sectional study was conducted at Department of Anatomy of Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan. It was conducted only after ethical clearance from the Institutional ethical Committee. An informed consent was taken from all the patients attending the

chemotherapy clinics of Bhagwan Mahaveer Cancer Hospital & Research Center, Jaipur and Acharya Tulsi Regional Cancer Treatment and Research Center, Bikaner. All the female patients who had carcinoma of breast aged 20 years or above were include in the study. The controls were female students of Mahatma Gandhi Medical College, Jaipur between the age group 20-21 years and prints of middle age (30-50 years) and elderly females (>50 years) were included from local areas of Jaipur, Rajasthan.

Procedure

Subjects' hands were washed with soap and water and the greasy material was cleared off with the help of ether. A small dab of printer's ink was squeezed out on the inking slab and was spread into thin even film with the help of a roller for direct inking of the fingers. Palm was smeared uniformly with the inked roller to cover the whole area of the palm to be printed for examination. The paper was set over the round bottle and the palm as well as moderately open fingers are successively rolled over with some pressure on it, permitting the bottle and paper to move forward, so that whole of the palm and plain finger prints are obtained. In Cummin's method, plain fingerprints had been recorded separately without rotation of the digit, simply by direct contact of the ball of the finger. The rolled finger prints were taken by rotation of the finger both in inking and printing so as to obtain a complete impression of the fingertip. Firstly, paper was laid, edge to edge upon smooth tabletop or glass sheet. Inking was completed by placing the edge down on the ink film and then rolled until the opposite margin meets the surface of the inking slab. This smears the finger from distal end to a level just proximal to the distal interphalangeal joint crease [3].

All patterns obtained (both patients and controls) were scanned and taken on computer and then further assessed. Different parameters like Ulnar loops (Lu), Radial loops (Lr), Whorl (W), Arch (A) and Palmar angles (atd, dat and adt) of finger-tip ridge pattern were studied.

Once the data was collected, a comparative analysis was conducted in both cancer and control group. Dermatoglyphic patterns (palm and finger) were examined bilaterally, focussing on all the above mentioned parameters and their fluctuation asymmetry was assessed.

Statistical Analysis

Under the assumption of symmetry, both hands should have identical values for all the above variables, Ulnar loop to radial loop; the counts are ranging 0 to 5. To obtain an idea about the symmetry of hands, the counts of right and left hands were cross tabulated and based on the agreement of counts, the asymmetry was determined. For example, if the number of arches in right hand of some subjects is '1' and the number of arches for left hand are more than '1' then it suggests disagreements in the counts of left and right hand. Suitable statistical tests were applied and p value less than 0.05 were considered significant.

Results

A total of 200 prints were studied. It included hundred palm and finger prints from cancer patients and hundred from controls. About 50% agreement was seen in terms of arch patterns between left and right hands i.e. about 50% cases and controls show fluctuation asymmetry. (Table 1)

Table 1: Distribution of Arch counts by status, hand and their agreement

Status	Hand	Left hand				% Agreement between counts
		Count	0	1	≥ 2	
Cases	Right hand	0	19	5	12	47
		1	4	7	5	
		≥ 2	3	7	25	
Controls	Right hand	0	40	20	6	50
		1	9	7	4	
		≥ 2	0	4	10	

Less than 50% agreement was seen in the radial loop pattern between left and right hand of cases. Only 23% agreement was seen in controls indicating fluctuation asymmetry. (Table 2)
About 60% agreement was seen between right and left hands of cancer patients. The agreement was seen to be less among (about 30%) controls indicating fluctuation asymmetry. (Table 2)

Table 2: Distribution of Radial loops (Lr) and whorls (W) counts by status, hands and their agreement

Radial loops (Lr) counts							
Status	Hand	Left hand					% Agreement between counts
		Count	0	1	2	≥3	
Cases	Right hand	0	18	10	2	6	43
		1	4	1	1	0	
		2	1	2	11	6	
		≥ 3	2	6	6	25	
Controls	Right hand	0	1	0	4	1	23

		1	3	4	2	1	
		2	1	7	4	13	
		≥ 3	0	5	16	38	
Whorls (W) counts							
Cases	Right hand	0	36	3	2	0	59
		1	11	10	11	2	
		≥3	2	0	2	5	
Controls	Right hand	0	17	5	14	0	29
		1	10	6	5	3	
		2	0	7	4	3	
		≥ 3	0	7	5	14	

In both cancer patients and controls, more than 80% agreement was seen in the controls of ulnar loops between right and left hands. (Table 3)

Table 3: Distribution of Ulnar loop counts by status, hand and their agreement

Status	Hand	Left hand				% Agreement between counts
		Count	0	1	≥ 2	
Cases	Right hand	0	84	1	5	84
		1	4	0	0	
		≥2	4	0	2	
Controls	Right hand	0	86	12	1	87
		1	1	0	0	
		≥2	0	0	0	

Subjects with arches more than one in right hand (left hand) had 5.7 times (4.9 times) higher risk of having breast cancer as compared to those having one or no Arch in their hands. (Table 4) Subjects with no Radial Loops in right hand (left hand), had 6.3 times higher risk of having breast cancer as compared to those having one or more radial loops in their hands. (Table 5)

Table 4: Distribution of subjects according to selected cut-off level of Arches, status, hands and odds ratio

Hand	Status	No. of Arches		Total	OR	P-value
		<2	>2			
Right	Cases	52	48	100	5.7	<0.001*
	Controls	86	14	100		
	Total	100	100	200		
Left	Cases	45	55	100	4.9	<0.001*
	Controls	80	20	100		
	Total	100	100	200		

*significant

Table 5: Distribution of subjects according to selected cut-off level of Radial Loops, status, hand and odds ratio (OR)

Hand	Status	No. of Radial loops		Total	OR	P-value
		0	≥1			
Right	Cases	36	64	100	8.8	<0.001*
	Controls	6	94	100		
	Total	100	100	200		
Left	Cases	25	75	100	6.3	<0.001*
	Controls	5	95	100		
	Total	100	100	200		

*significant

A fluctuation asymmetry was observed in absolute finger ridge count (AFRC). The mean values of (right hand) AFRC in carcinoma breast patients were less as compared to mean AFRC value in controls. The decrease in values was significant ($p<0.05$). (Table 6) The a-b ridge count did not vary between cases and controls probably suggesting that a-b ridge count is not associated with occurrence of breast cancer. The 'atd' angle for right and left hand did not vary significantly for both cancer patients as well as controls. No fluctuation asymmetry was noted. The 'tda' angle of right hand of both cases and controls was significantly less ($p<0.05$). A fluctuation asymmetry was noted for right 'tda' angle of both cancer patients as well as controls. The 'dat' angle showed a different pattern. The 'dat' angle of right

hand of cancer patients was less as compared to controls ($p<0.01$). A fluctuation asymmetry was noted in 'dat' angle. (Table 6)

Table 6: Comparison between status and hands for absolute finger ridge count, a-b ridge, atd, tda and dat angle

Status	Hand	Mean±SD	P-value
absolute finger ridge count			
Control	Left	90.9±36.92	>0.05
	Right	95.8±45.74	
Carcinoma breast	Left	62.9±44.40	<0.05*
	Right	70.5±47.17	
a-b ridge count			
Control	Left	40.3±6.70	>0.05
	Right	39.0±6.16	
Carcinoma breast	Left	40.0±6.23	>0.05
	Right	38.9±5.00	
atd angle			
Controls	Left	42.7±5.34	>0.05
	Right	43.7±6.11	
Carcinoma breast	Left	44.6±5.56	>0.05
	Right	45.2±6.49	
tda angle			
Controls	Left	76.9±5.72	<0.05*
	Right	78.4±4.47	
Carcinoma breast	Left	75.5±7.09	<0.05*
	Right	77.2±6.49	
dat angle			
Controls	Left	60.4±5.79	<0.01*
	Right	58.0±5.37	
Carcinoma breast	Left	60.1±6.82	<0.01*
	Right	57.7±6.83	

*significant

Discussion

Fluctuating asymmetry has been investigated in various conditions as a potential marker of developmental disturbances, genetic factors and overall health [6]. In the context of breast cancer, studying fluctuation asymmetry in dermatoglyphics aims to explore potential associations between asymmetry patterns and the disease.

In the present study, fluctuation asymmetry was observed in index finger, middle finger and little finger of cancer patients. TFRC, AFRC, <tda and <dat also showed asymmetry in cancer patients.

Based on arch pattern, about 50% agreement was seen in right and left hands of both cancer patients and controls. Based on loop radius patterns, less than 50% agreement was seen in right and left hands of cancer patients. Only 23% agreement was seen in controls. Based on loop ulnar patterns more than 80% agreement was seen between right and left hands of both cancer patients and controls. Based on whorl patterns 60% agreement was seen in cancer patients and less than 30% agreement was seen in controls.

In a study conducted by Natekar et al, fluctuation asymmetry was found to be statistically significant in thumb, subtotal ridge count and <atd of carcinoma breast patients [5]. Prathap et al also studied the fluctuating asymmetry on typical dermatoglyphic variables on three groups i.e controls, cases and high risk groups. Their study confirmed that dermatoglyphic studies can be utilized to isolate the high risk population [7].

Trojan et al study recently found that women with macromastia/gigantomastia, there exists a rationale for implementing earlier and more frequent prophylactic breast imaging. The basis for such speculations stems from study conducted by Trojan et al that have demonstrated positive correlations between breast size, asymmetry and the risk of developing cancer [8]. Yaneva et al conducted a study in 2019 to investigate fluctuating asymmetry in patients with carcinoma breast. They specifically compared the palmar ridge counts of different finger combinations (a-b II, c-d IV, and a-d). Their study found that breast cancer females exhibited higher fluctuating asymmetry values compared to healthy controls. Furthermore, there was a greater correlation (1-r2) of fluctuation asymmetry in the ridge count of homologous thumbs, forefingers and little fingers of both hands in breast cancer females compared to healthy controls.

The authors suggested that these traits could potentially be utilised in diagnostic algorithm for breast cancer screening among genetically predisposed female population [9].

Conclusion

The present study concluded that there was significant relationship between fluctuation asymmetry and breast cancer patients. Thus fluctuation asymmetry in dermatoglyphics can be used as an effective screening tool in high-risk cases as well as early treatment can be started which will be beneficial to the patient and society as a whole.

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