

Research Article

Dermatoglyphics and Cheiloscopy Patterns in Cancer Patients; A Study in Ahmadu Bello University Teaching Hospital (ABUTH), Zaria, Nigeria

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Abstract: The aim of this study was to determine the association between digital dermatoglyphics of the hands and lip prints with cancer. Dermatoglyphics has proved to be a very important tool used for identification of many gene-linked abnormalities or diseases. Same can also be said of Lip prints which as dermatoglyphics are unique to individuals and has been shown to be a useful genetic markers in some congenital and clinical diseases. It has been used widely as a marker for the inheritance of cleft lip deformity. The study was conducted using 100 confirmed cancer patients. The digital dermatoglyphic patterns were studied using method of Cummins while the lip prints were identified and classified according to method of Suzuki and Tsuchihashi (1970). A control group of healthy subjects numbering 126 without familial history of diagnosed cancer were selected at random. Associations between the variables were tested using the Chi-square test for independence. The result indicated statistically significant association between finger print pattern and lip prints of the female and cervical cancer. The cervical cancer group presented with 74.9% of loop pattern on the right compared to the 64.0% in the normal, while the left hands had 68.5% in the case compared to the 61.2% ($p < 0.001$). While the lip prints in the cancer cases were found to have high percentage of the branched type; 62.4%, compared to the 56.5% in the normal. In conclusion, dermatoglyphics and cheiloscopy can be used as a maker in the detection of females at risk of developing cervical cancer.

Keywords: Association, cancer, finger print, lip patterns, Nigeria

INTRODUCTION

Personal identification is becoming increasingly important not only in legal medicine but also in criminal investigation and identification, In anatomy, a fingerprint is a trace, print or scan of the friction ridges of the skin of any finger that serve as unique identification markers (Merriam Webster Collegiate Dictionary, 2000). The word "Dermatoglyphics" is derived from the Greek word 'Derma' meaning skin and 'Glyphic' meaning carvings (Schaumann and Alter, 1976). In humans, dermatoglyphs are present on fingers, palms, toes and soles and can give insight into a critical period of embryogenesis, when the architecture of the major organ systems are developing. Unusual dermatoglyphic patterns often relate to genetic disorders, such as Down's syndrome, Turner's syndrome or Klinefelter's syndrome etc. Shiono (1986). Dermal ridge differentiation takes place early in foetal development. The resulting ridge configurations are genetically determined and influenced or modified by environmental forces (Schaumann and Alter, 1976). The dermal ridge develops in relation to the volar pads, which are formed by the 6th weeks of gestation and reach maximum size between 12th and 13th weeks. This means that the genetic message contained in the

genome normal or abnormal is deciphered during this period and is also reflected by dermatoglyphics (Mathew *et al.*, 2005). Dermatoglyphic patterns stay constant during life and may sometimes play a significant role in diagnosis of many disorders with genetic background (Alter, 1967).

The theory of uniqueness is a strong point used in the analysis of finger prints and bite marks to convince the court of law. Likewise even lip prints and palatal rugues patterns are considered to be unique to an individual and hence hold the potential for identification. The wrinkle and grooves on the labial mucosa (sulci labiorum) form a characteristic pattern called 'lip print'. The study of these prints and wrinkles is known as Cheiloscopy (Acharya and Sivapathasundharam, 2006; Sivapathasundharam *et al.*, 2001). Cheiloscopy is a forensic investigation technique that deals with the identification based on lip traces. Lip prints, as one of the dermatoglyphics, are being studied for use as genetic markers in many congenital and clinical diseases. It has been used widely as a marker for the inheritance of cleft lip deformity (Afaf *et al.*, 1987). Lip prints have been shown to be genetically related and can be inherited from parents. It has also been used in the investigation of post-mortem changes (Utsuno *et al.*, 2005).

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Cancer is one of the menaces of our generation. It is class of diseases characterized by out-of-control growth of cells. Most cancers occur due to abnormalities in DNA sequence (Kinzler and Vogelstein, 2002). Throughout life, the genome within cells of the human body is exposed to mutagens in replication; these corrosive influences result in progressive, subtle, divergence of the DNA sequence in each cell from that originally constituted in the fertilized egg. There are over 200 different types of cancer and each is classified by the type of cells that is initially affected (www.cancerresearchuk.org). Cancer harms the body when damaged cells divide uncontrollably to form lumps or masses of tissues called 'Tumours' (except in the case of leukaemia where cancer prohibits normal blood function by abnormal cell division in the blood stream). Tumours can grow and interfere with the digestive, nervous, circulatory systems and they can release hormones that alter body function (www.cancerresearchuk.org). Cancer, no matter the cause ultimately results in cells that uncontrollably grow and do not die (Varricchio, 2002). In 2007, cancer is reported to have claimed the lives of about 7.6 million people in the world (Jemal *et al.*, 2011). Physicians that are specialist in this field have devised means of diagnosis, treatment and prevention of this disorder. The aim of this research is to determine if any specific pattern can be considered as a genetic marker and thus be used for the expectance of any type of cancer.

MATERIALS AND METHODS

Ethical approval was obtained and informed consent also obtained from the study subjects. The study was carried out on hundred (100) histopathological confirmed malignant neoplasm patients of age range 25 to 70 years attending clinic in oncology clinic in Ahmadu Bello University Teaching Hospital (ABUTH), Zaria between January and October, 2012. One hundred and twenty six (126) adults with no history of any malignant neoplasm were used as control group. The age of the control population was between 25-90 years. An ink print palm and finger print method of Cummins was used in collection of finger prints. This was done after cleaning of the two hands to avoid dirt from the hands. The prints were made on the white papers which were later screened with the aid of the magnifying hand lens to reveal the finger print pattern, in accordance with Cummins's method (Cummins, 1929). The digital patterns were recorded as whorls (W), Loop (L) and Arch (A). For the lip prints, care was taken to select individuals without lesions on the lips. The subjects were made to sit in a relaxed position and after cleaning the lips; lip prints was made on the glass slide in a single motion without applying any sticky substance. This was then developed by dusting fine carbon black powder with an ostrich brush and the type of the lip prints was studied using a magnifying lens (Suzuki and Tsuchihashi, 1970). Then

the lip prints were studied carefully using the magnifying hand lens (x5) which reveal the furrows of the lip in bright light to identify and classify according to Suzuki and Tsuchihashi (1970). Employing the dental formula generally used, the lip prints were divided onto four quadrants and recorded as:

Right Upper quadrant	RU
Right lower quadrant	RL
Left upper quadrant	LU
Left lower quadrant	LL

The data were analysed. The pattern of Suzuki and Tsuchihashi (1970) was used in the presentation of the data, which include:

- **Type I** : Clear-cut grooves running vertically across the lip (complete vertical)
- **Type I'** : The grooves are straight but disappear half way instead of covering the entire breadth of the lip (incomplete vertical)
- **Type II** : The grooves are branched
- **Type III** : The grooves are reticular
- **Type IV** : The grooves are intersected
- **Type V** : The grooves do not fall into any of the types above and cannot be differentiated morphologically.

All data collected are presented as frequencies and percentages. Associations between the variables were tested using the Chi-square test for independence. A p-value of <0.05 was considered significant for all analysis. The WinSTAT® for Microsoft® Excel version 2012.1 (Fitch, 2012) was used for the statistical analysis.

RESULTS

The total cancer cases obtained were 100 and the different types were are as follows:

• Cervical cancer	47
• Female breast cancer	18
• Uterus	5
• Eye	4
• Rectum	3
• Mouth	4
• Lungs	4
• Larynx	3
• Nasopharyngeal	3
• Intestinal	4
• Osteosarcoma	2
• Urinary bladder	1
• Skin	1
• Leg	1

The results of the data collected were categorized into five groups for purposes of analysis and are

Table 1: Frequency and percentage of the finger prints of all cancer patients and normal subjects

Pattern	Right hand		Left hand	
	Cancer	Normal	Cancer	Normal
Loop	343 (68.6%)	406 (64.4%)	332 (64.4%)	400 (63.5%)
Whorl	127 (25.4%)	167 (26.5%)	129 (25.8%)	155 (24.6%)
Arch	30 (6.0%)	57 (9.1%)	49 (9.8%)	75 (11.9%)

$\chi^2 = 4.22$, $df = 2$, $P = 0.12$, $\chi^2 = 1.32$, $df = 2$, $P = 0.52$; Sample size: normal = 126, cancer = 100

Table 2: Frequency and percentage of the finger prints male cancer patients and all normal male subjects

Pattern	Right hand		Left hand	
	Cancer	Normal	Cancer	Normal
Loop	73 (66.4%)	246 (64.7%)	68 (61.8%)	247 (65.0%)
Whorl	32 (29.1%)	114 (30.0%)	31 (28.1%)	103 (27.1%)
Arch	5 (4.6%)	20 (5.3%)	11 (10.0%)	30 (7.8%)

$\chi^2 = 0.14$, $df = 2$, $P = 0.93$, $\chi^2 = 0.62$, $df = 2$, $P = 0.73$; Sample size; normal = 76, cancer = 22

Table 3: Frequency and percentage of the finger prints of female cancer patients and normal female subjects

Pattern	Right hand		Left hand	
	Cancer	Normal	Cancer	Normal
Loop	270 (69.2%)	160 (64.0%)	254 (65.4%)	153 (61.2%)
Whorl	95 (24.4%)	53 (21.2%)	97 (24.9%)	52 (20.8%)
Arch	25 (6.4%)	37 (14.8%)	39 (10.0%)	45 (18.0%)

$\chi^2 = 12.35$, $df = 2$, $P = 0.002$, $\chi^2 = 8.88$, $df = 2$, $P = 0.01$ Sample size: normal = 50, cancer = 78

Table 4: Frequency and percentage of the finger prints of cervical cancer patients and normal female subjects

Pattern	Right hand		Left hand	
	Cancer	Normal	Cancer	Normal
Loop	176 (74.9%)	160 (64.0%)	161 (68.5%)	153 (61.2%)
Whorl	49 (20.9%)	53 (21.2%)	59 (25.1%)	52 (20.0%)
Arch	10 (4.3%)	37 (14.8%)	15 (6.4%)	45 (18.0%)

$\chi^2 = 15.98$, $df = 2$, $P = 0.0003$; $\chi^2 = 15.19$, $df = 2$, $P = 0.0005$; Sample size; normal = 50, cancer = 47

Table 5: Frequency and percentage of the finger prints of female breast cancer patients and normal female subjects

Pattern	Right hand		Left hand	
	Cancer	Normal	Cancer	Normal
Loop	58 (64.4%)	160 (64.0%)	56 (62.2%)	153 (61.0%)
Whorl	20 (22.2%)	53 (21.2%)	16 (17.8%)	52 (20.8%)
Arch	12 (14.8%)	37 (13.3%)	18 (20.0%)	45 (18.0%)

$\chi^2 = 0.13$, $df = 2$, $P = 0.94$; $\chi^2 = 0.46$, $df = 2$, $P = 0.79$; Sample size: normal = 50, cancer = 18

presented in the Table 1. Comparisons were made between Total cancer patients and normal population, Total female cancer patients and normal females, total male cancer patients and normal males, cervical cancer patients and normal females and female breast cancer patients and normal females.

The normal subjects were found to have the higher value of loop on their right hands (64.4%), followed by whorl (26.5%) then the arch type (9.1%). On the left, the following percentages were obtained for loop, whorl and arch in the normal (63.5), (24.6) and (11.9%), respectively. There was no association between the finger print pattern and cancer.

In the Table 2, normal males presented with higher frequency of loop in left hand of normal group (65%) as against (61.8%) in cancer male group, while the right hand had higher loop in cancer cases (66.4%) as against

(64.7%) in normal male group. The whorl pattern was higher on the right hand (30.0%), the frequency of the arch pattern was less for the right hand too (4.6%). There was no association between the finger print pattern and male cancer patients.

In this group, the female cancers cases had higher percentage frequency of loop with the right hand and left hands having (69.2%) and (65.4%) respectively. They also had reduced value of arch having (6.4%) and 10% for right and left respectively. The values of the arch on the right hand in the normal female showed a higher value (14.8%) and on the left (18.0%). There is a strong association between the finger print pattern and female cancer patient ($p < 0.05$). (Table 3)

The right and left hands showed high frequency of loop as 74.9% and 68.5% respectively in the cancer cases and a reduced value of whorl (20.9%) and arch (4.3%) in the right hand. On the left hand, the percentage frequency of whorl and arch are higher than the right hand having 25.1 and 6.4% respectively. The left hands of normal subject had 20.0 & 18.0% for whorl and arch, respectively while the right had 21.2 and 14.8% for whorl and arch respectively. There was significant association between the finger print pattern and cervical cancer at $p < 0.001$. (Table 4)

Though there is drastic increase of the three patterns in the normal females than in the cancer cases, the cancer cases seem to be presented with higher percentage of loop on both as 64.4 & 62.2%, respectively, this is followed by whorl and arch in the order 22.2 and 14.8% (right) and 17.8 and 20.0% (left). There was no association between the finger print pattern and breast cancer (Table 5).

The branched type stands out to be the most frequently occurring. But the cancer cases showed higher percentage of occurrence with 60.5%, followed in the order by reticular (20.4%), intersected (10.1%), long vertical 5.8% and undifferentiated 3.3%, the percentage of reticular and arch is higher in the normal i.e., 27.8 and 6.8%, respectively. There was no association between the lip print pattern and cancer. (Table 6)

The branched have the highest frequency in both the normal (51.6%) and cancer cases (62.8%). This is followed by the reticular, intersected, undifferentiated and long vertical types in the order (22.1), (8.1), (6.9) and (0%), respectively. The percentage frequency of reticular, intersected and long vertical is higher in the normal subjects. There was no association between the lip print pattern and cancer in the male subjects. (Table 7)

The frequency of the pattern in the Table 8, increased in the cancer cases with the branched type highest (59.8%), followed in the order by the reticular (19.9%), intersected (10.6%), long vertical (7.3%) and undifferentiated (2.37%), while the values for the normal were lesser except in the reticular (24.0%) and

Table 6: Frequency and percentage of lip print in all cancer patients and all normal subjects

Pattern	Long Vertical	Branched	Reticular	Intersected	Undifferentiated
Normal	34 (6.8%)	270 (53.6%)	140(27.8%)	46(9.1%)	14(2.8%)
Cancer	23(5.8%)	240(60.5%)	81(20.4%)	40(10.1%)	13(3.3%)

$\chi^2 = 7.49$, $df = 4$, $P = 0.11$ Sample size: normal 126, cancer = 100

Table 7: Frequency and percentage of lip print in total male cancer patients and male normal subjects

Pattern	Long Vertical	Branched	Reticular	Intersected	Undifferentiated
Normal	107(3.3%)	157(51.6%)	92(30.3%)	31(10.2%)	14(4.6%)
Cancer	0(0%)	54(62.8%)	19(22.1%)	7(8.1%)	6(6.9%)

$\chi^2 = 6.97$, $df = 4$, $P = 0.14$ Sample size: normal = 76, cancer = 22

Table 8: Frequency and percentage of lip print in all female cancer patients and normal female subjects

Pattern	Long Vertical	Branched	Reticular	Intersected	Undifferentiated
Normal	24(12.0%)	113(56.5%)	48(24.0%)	15(7.5%)	0(0%)
Cancer	23(7.3%)	186(59.8%)	62(19.9%)	33(10.6%)	7(2.3%)

$\chi^2 = 9.72$, $df = 4$, $P = 0.04$; Sample size: normal = 50, cancer = 78

Table 9: Frequency and percentage of lip print in cervical cancer patients and normal female subjects

Pattern	Long Vertical	Branched	Reticular	Intersected	Undifferentiated
Normal	24(12.0%)	113(56.5%)	48(24.0%)	15(7.5%)	0(0%)
Cancer	9(4.8%)	116(62.4%)	32(17.2%)	25(13.4%)	4(2.2%)

$\chi^2 = 16.07$, $df = 4$, $P = 0.003$; Sample size: normal = 50, cancer = 47

Table 10: Frequency and percentage of lip print in female breast cancer patients and normal female subject

Pattern	Long Vertical	Branched	Reticular	Intersected	Undifferentiated
Normal	24(12.0%)	113(56.5%)	48(24.0%)	15(7.5%)	0(0%)
Cancer	6(8.3%)	40(55.6%)	18(25.0%)	8(11.1%)	0(0%)

$\chi^2 = 1.49$, $df = 4$, $P = 0.83$ Sample size: normal = 50, cancer = 18

long vertical (12.0%) types. There was association between the lip print pattern and cancer in the females.

The cancer cases have a higher value of branched type (62.4%), followed in the order by reticular (17.2%), intersected (13.4%), long vertical (4.8%) and undifferentiated (2.2%). But the values of reticular and long vertical were higher in the normal subjects (24.0 and 12.0%), respectively. There was association between the lip print pattern and cervical cancer in the females $p < 0.05$. (Table 9).

The normal subjects were presented with higher values of all the types with the branched type predominant (56.5%). There was no identification of the undifferentiated type in this group in both the cancer cases and the normal subjects. There was no association between the lip print pattern and breast cancer in females. (Table 10)

DISCUSSION

Some documented studies have been done on dermatoglyphics and cancer while very little exist on cheiloscopy and cancer. The findings of this study revealed loop pattern as having the highest frequency of occurrence in both bands and this agrees with the work of Seidman *et al.* (1982) and Hung and Mi (1987). They reported the association of cancer with higher proportion of loop finger print pattern. In the present study however, though the loop print was high but the association was not significant. The right hand had more loop than the left, in the total cancer cases having 68.6 and 64.4% respectively; and this compared with

that of the normal which had 64.4 and 63.5% for right and left respectively (Table 1). For the lip prints of all cancer cases and normal subject (Table 6), the branched type (type II) had the highest frequency of occurrence, followed by reticular (type III) and interested types (type IV); the total cancer cases where 60.5%, 20.4% and 10.1% for branched (type II), reticular (type III); and interested (type IV) respectively, while the values of the normal subjects of 53.6, 27.8 and 6.8% for branched, reticular and intersected, respectively. There was no association between the total lip print pattern and cancer. In Table 2 which had the data of the male group, the male cancer case had higher frequency of loop pattern in the right hand, while the left hand had lesser loops with percentage of 61.8% when compared to the normal. In the work of Oladipo *et al.* (2009), it was found that prostate cancer patients had either higher value of loop or whorl pattern and this was same in the normal subjects. This finding was similar to the finding in this research; however, there was no association between finger print pattern and cancer in this study. For the lip print pattern in males (Table 7) it shows higher percentages of branched in the cancer case 62.8% compared to 51.6% observed in the normal, while the other types were found to have lower values in the cancer cases compared to the normal, however, there was no association between the lip pattern and cancer in the male subjects. In the total female cancer group (Table 3), the study revealed that, the right hand of the cancer cases had a percentage frequency of (69.2%) as compared to that of the normal of (64.0%), while the left hand had frequency of loop print to be

(65.4) and (61.2%) in the cancer cases and the normal subjects respectively. The values were lower in both hands than the cancer group and values of 0.002 and 0.01 for P for right and left respectively shows that it is 99% statistically significant. This indicates a strong association between finger print pattern and female cancer. For the lip print pattern in females cancer cases (Table 8), the branched pattern had the highest frequency (59.8%), followed in the order by the reticular (19.9%), intersected (10.6%), long vertical (7.3%) and undifferentiated (2.37%), while the values for the normal were lesser except in the reticular (24.0%) and long vertical (12.0%) types. There was association between the lip print pattern and total cancer cases in the females. In the cervical cancer cases (Table 4) there were 74.9% of loop on the right and 68.5% on the left, while the normal females had 64.0 and 61.2% on the right and left, respectively. This is significantly higher in cancer cases and probably accounted for the significant association observed and maybe an indicator that the incidence of cervical cancer is higher among females with loop finger print. This data was found to be above 99% statistically significant with low frequency of whorl and arch patterns. This findings are contrary to the finding of Reddy *et al.* (1977) who observed significant high frequency ($p < 0.05$) for whorls only and Pal *et al.* (1985) who observed significant high frequency for arches ($p < 0.001$) and low frequency of Loop (ulnar loop) ($p < 0.05$) in cervical cancer females when compared to control subjects. Vaishali *et al.* (2006) also found high frequency of whorls and low frequency of Ulnar Loop on both hands but frequency of arches was increased on left hand. For the lip prints in the cervical cancer cases, Table 9) branched had 62.4% reticular 17.2% and intersected 13.4% compared to the normal with 56.6%, 24% and 7.5% for the branched, reticular and intersected respectively. The frequency of all patterns was higher in the normal cases except in the reticular and long vertical types which were much lower in cancer cases. Also the undifferentiated was not present in the normal group. This group had value of P to be 0.003, with 99% significance. It can be said that females with very high frequency of undifferentiated, branched and intersected print patterns on their lips are at higher risk of developing cervical cancer, while reticular has a lower risk in future. The results on Table 5 show the breast cancer and the normal female subjects, in this group P was above 0.05 indicating no association between finger print pattern and breast cancer. This is a variance with some studies carried out on dermatoglyphic of breast cancer patients by some researchers like Sridevi *et al.*, (2010) showed an increased frequency of loop in both hands with p values of 0.009 and 0.032 for the right and left hands respectively in the breast cancer patients. Beirman *et al.*, 1989 showed the loop to be significantly

associated with breast cancer. This was reported in the work of Oladipo *et al.* (2009) in the study of digit and palmer dermatoglyphic patterns of Nigerian women with malignant mammary neoplasm, found a significant association ($p < 0.05$) between ulnar loop and breast cancer. For lip print patterns (Table 10) the frequencies of the pattern observed were not significantly different between the cancer cases and normal group, there was no association between the lip print pattern and breast cancer.

CONCLUSION

With the results obtained from this study, it can be said that the lip print and finger print patterns of only the female and in particular those with cervical cancer can be used as risk indicator since they have 95 and 99% statistical significant association with cancer. This may be used as a preliminary screening to determine those at risk of developing cervical cancer and proper monitoring can be instituted to prevent morbidity and mortality associated with this condition.

REFERENCES

- Acharya, A.B. and B. Sivapathasundharam, 2006. Forensic Odontology. In: Rajendran, R. and B. Sivapathasundharam (Eds.), Shafer's Textbook of Oral Pathology. 5th Edn., Elsevier, New Delhi, pp: 99-227.
- Afaf, T.Y., E. Amal and S. Mahmoud, 1987. The inheritance of lip print patterns. *Tanta Med. J.*, 1(1): 26.
- Alter, 1967. Dermatoglyphic analysis as a diagnostic tool. *Medicine*, 46: 35-56.
- Hung, C. and M. Mi, 1987. Digital dermatoglyphic pattern in breast cancer. *Proc. Natl. Sci. Coune. Repub. China*, 11: 133-136.
- Jemal, A., F. Bray, M.M. Center, J. Ferlay, E. Ward and D. Forman, 2011. Global cancer statistics. *CA: A Cancer J. Clinic.*, 61(2): 6990.
- Kinzler, K.W. and B. Vogelstein, 2002. Introduction" The Genetic Basis of Human Cancer. 2nd (Ed.), McGraw-Hill, New York, p: 5.
- Mathew, L., A.M. Hegde and K. Rai, 2005. Dermatoglyphics peculiarities in children with Oral clefts. *J. Indian Soc. Pedod Prev. Dent*, 23(4): 179-82.
- Merriam Webster Collegiate Dictionary, 2000, Retrieved from: <http://www.merriam-webster.com>.
- Oladipo, G.S., C.W. Paul, I.F. Bob-Manuel, H.B. Fawehinmi and E.I. Edibamode, 2009. Study of digital and palmar dermatoglyphic patterns of Nigerian women with malignant mammary neoplasm. *J. Appl. Biosci.*, 15: 829-834.
- Pal, G.P., R.V. Roufal and S.S. Bhagwat, 1985. Dermatoglyphics in carcinoma cervix. *J. Anatom. Soc. India*, 34(3): 157-161.

- Reddy, S.S., Y.A. Ahuja and O.S. Reddy, 1977. Dermatoglyphic studies in Carcinoma of cervix. *Indian J. Heredity*, 9: 35-40.
- Seidman, H.M., S.D. Steiiman and M.H. Mushinski, 1982. A difference perspective on breast cancer risk factors: Some implications of the non-attributable risk. *Cancer Res.*, 32: 301-313.
- Shiono, H., 1986. *Palmistry for Evolutionary Man*. West Port, Associated Booksellers, Conn, pp: 40-43.
- Sivapathasundharam, B., P.A. Prakash and G. Sivakumar, 2001. Lip print (Cheiloscopy). *Indian J. Dent Res.*, 12: 234-237.
- Schaumann, B. and M. Alter, 1976. *Dermatoglyphics in Medical Disorders*. Springer Verlag, New York.
- Suzuki, K. and Y. Tsuchihashi, 1970. Personal identification by means of lip print. *J. Forensic Med.*, 17(2): 52-57.
- Utsuno, H., T. Kano, O. Tadokoro and K. Inoue, 2005. Preliminary study of post mortem identification using lip print. *Forensic Sci. Int.*, 149: 129-132.
- Vaishali, V.I., S.A. Vaidya, K. Pratima, D.B. Dervarshi, K. Shailesh and L.T. Sudhir, 2006. Dermatoglyphics in carcinoma cervix. *J. Anat. Soc. India*, 55(1): 57-59.