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Formulation of Transverse Flexion Creases: Validation of Inheritance, Twin Diagnosis and Ethnic Variation.

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Abstract: *The study of palmar flexion creases equips the human biologist as well as anthropologist, with a new kit for qualitative data and for fully objective norms for comparing the deferent population. Here an attempt is made to formulate new classification of tranverse flexion creases their validation of inheritance, twin diagnosis and ethnic variation. This classification is more effectively applied in the study of ethnic variations etc. For the validity of the classification 100 families of Gonds and 126 pairs of twins (including di-zygotic and mono zygotic) were investigated simultaneously, the formulation is tested through the study of two populations i.e., Kacchis and Brahmins 150 males and 150 females, unrelated individuals were selected from each group, from Sagar district, Madhya Pradesh, India. The results exhibit inheritance and ethnic variation.*

Key words: *Radial longitudinal crease, Proximal transverse crease, Distal transverse crease*

I. INTRODUCTION

Creases occur on the palmar, plantar, and phalangeal surface and are devoid of dermal configurations. The study of palmar flexion creases were firstly done by Broka (1873). According to Park et al (2010) 'Palmar creases are useful in the anthropological traits and for diagnosing the disorders and chromosomal abnormalities, they have analyzed through qualitative and quantitatively'.

Tay (1979), studied the mode of inheritance among first degree relatives and found significant increment of frequency in the parents to compare with control groups which have genetic factors in their embryogenesis.

Various scholars presented the different-different formulations of palmar flexion creases viz., Bhanu (1972), Dar et al.(1977), Bali and chobe (1971) and, Bali and Sharma(1989), Adetona et al (2012), and Adetona and Moses (2014), which are not much effective in the study of human variations. To solve this problem, here an attempt is made to present a new palmar crease formulation, in which attempt have been made to remove problems of palmar classification.

The objective of the present study is to establish a new formulation of Transverse flexion creases and prove the validation through inheritance, twin diagnosis and ethnic variation.

II. MATERIAL AND METHOD

The data were collected from Sagar district of Madhya Pradesh, India. Sagar district is situated in north-east area of Madhya Pradesh, it lies between latitude 23.83' north and longitude 78.71' east. For the present study 100 families of Gonds population were examine for the study of inheritance. The Gonds is the principal tribe of the Dravidian family and it's a important non-aryan tribe or forest tribe in India. It is Second largest populated tribe of India. The 126 pairs of twins (mono-zygotic and di-zygotic) were examine for twin diagnosis. The mono-zygotic and di-zygotic twins were identified on the bases of number of placenta.

The 150 males and 150 females individuals were selected from two endogamous groups i.e., Brahmins and Kacchis. The Brahmin are well known priestly caste of India, it comes first of the four traditional caste of sculpture it is a strictly endogamous population. The Kacchis are also an endogamous caste of India; basically it's a vegetable grower population of India. Data were collected randomly from unrelated individuals. For taken the bilateral prints of palm the method prescribed by Cummins and Midlo (1961) is fully adopted. For the analysis of transverse flexion crease the new proposed formulation is adopted, the formulation of transverse flexion creases is as follow :

III. PROPOSED NEW CLASSIFICATION

The proposed new transverse flexion crease classification is basically based on the main palmar creases i.e., radial longitudinal crease, proximal transverse crease and distal transverse crease. This classification is

based only on the trends of distal and proximal transverse creases. On the basis of their trends transverse flexion creases are classified in to 15 categories.

1. Transverse flexion creases I (TFC I) :- In this case only two creases are present on the palm i.e., radial longitudinal crease, distal transverse crease/ simian crease and joints at the same point on radial side.in point.(Fig.1)

2. Transverse flexion creases II (TFC II) :- In this condition all the three creases i.e., radial longitudinal crease, proximal transverse crease and distal transverse crease are present and joint at radial marginal of the palm (Fig.2)

3. Transverse flexion creases III (TFC III) :- In this condition radial longitudinal crease and distal transverse crease/ simian crease are present and both creases are separated at radial side(Fig.3)

4. Transverse flexion creases IV (TFC IV) :- In this case initially distal transverse crease runs straight and its terminal end turns upwards(towards digit II^{nd} / II^{nd} inter digital area), whereas proximal transverse crease occurs straight and small in size (approximate up to IV^{th} digit)(Fig.4)

5. Transverse flexion creases V (TFC V) :- In this condition (Fig.5) both proximal transverse crease and distal transverse crease occurs straight and small in size (approximate half of its natural lengths)

6. Transverse flexion creases VI (TFC VI) :- In this condition (Fig.6) distal transverse crease occurs straight and found natural in length, where as proximal transverse crease also occurs straight but small in size (approximate up to IV^{th} digit)

7. Transverse flexion creases VII (TFC VII) :- In this case (Fig.7) the terminal end of distal transverse crease turned upward (towards approximate II^{nd} digital area/ II^{nd} inter digital area), but the terminal end of proximal transverse crease turned down ward (toward proximal area)

8. Transverse flexion creases VIII (TFC VIII) :- In this case (Fig.8) distal transverse crease occurs straight and covered full length i.e., covered both the ends of palm, where as the proximal transverse crease occurs straight and found small in size (approximate up to IV^{th} digit of the palm)

9. Transverse flexion creases IX (TFC IX) :- In this condition radial longitudinal crease and proximal transverse crease runs simultaneously up to certain distance from radial side, further proximal transverse crease and distal transverse crease occurs in straight manner and observed natural in length (Fig.9)

10. Transverse flexion creases X (TFC X) :- In this case (Fig.10) distal transverse crease occurs straight but the terminal end of proximal transverse crease is curved down ward (towards proximal area).

11. Transverse flexion creases XI (TFC XI) :- In this condition the terminal end of distal transverse crease is curved upward toward I^{st} digital and II^{nd} inter digital area, where as proximal transverse crease occurs in full length and its terminal end turned towards ulnar side (Fig.11)

12. Transverse flexion creases XII (TFC XII) :- In this case (Fig.12) distal transverse crease runs straight (approximate up to 3^{rd} digit) and then its terminal end turned upward (towards II^{nd} digital area / II^{nd} inter digital area), while proximal transverse crease joint on the radial longitudinal crease after some distance and occurs small in size. (up to IV^{th} inter digital area)

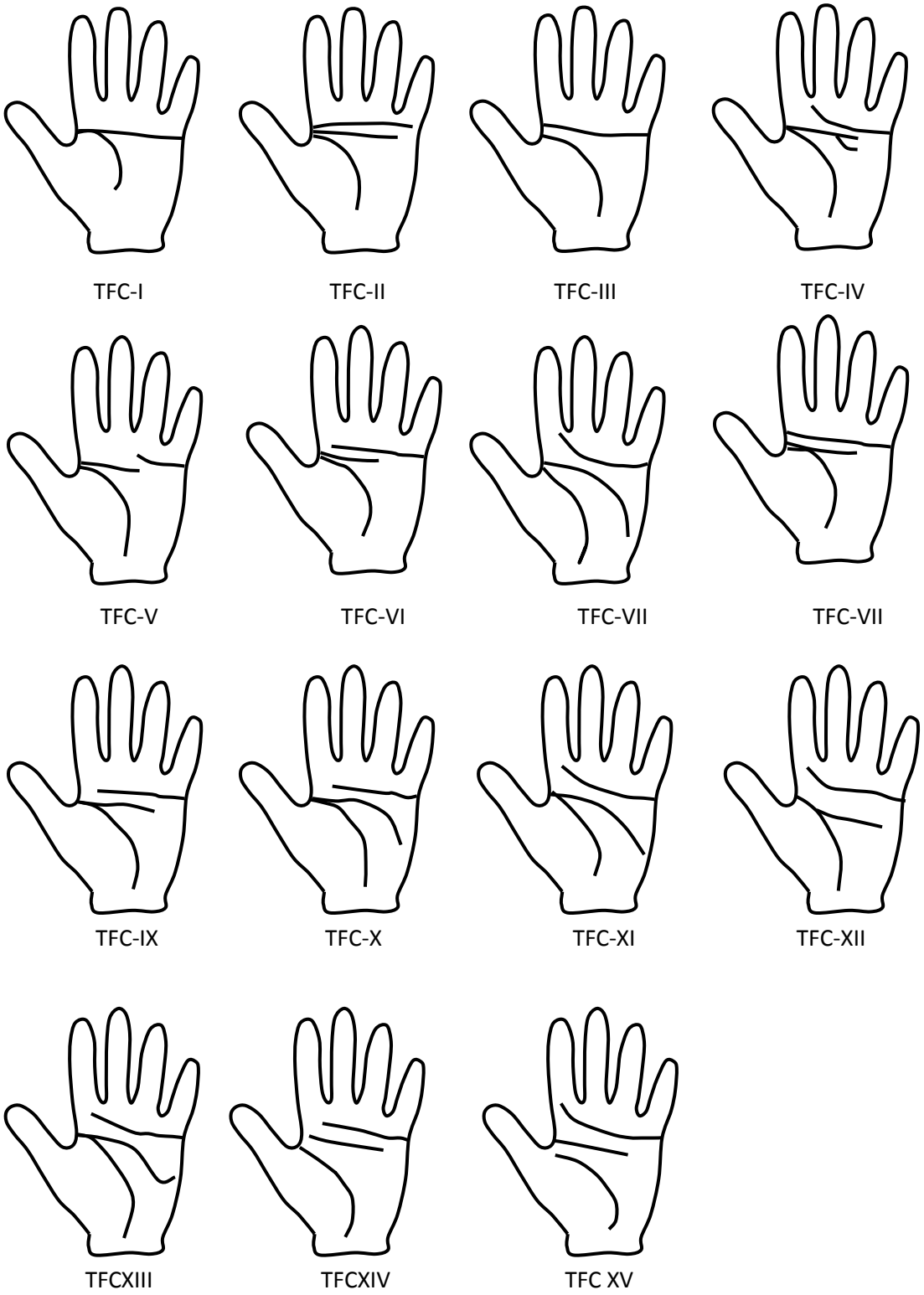
13. Transverse flexion creases XIII (TFC XIII) :- In this case distal transverse crease occurs wavy in nature i.e., curves in the middle but the terminal end of proximal transverse crease shows wavy in nature and its terminal end upward toward ulnar side (Fig.13)

14. Transverse flexion creases XIV (TFC XIV) :- In this condition all these three creases occur on the palm i.e., distal transverse crease, proximal transverse crease and radial longitudinal crease and all the three creases are separated from each other at both the ends (Fig.14)

15. Transverse flexion creases XV (TFC XV) :- In this case (Fig.15) distal transverse crease occurs curved and its terminal end runs upward (toward II^{nd} digital/ II^{nd} inter digital area), where as proximal transverse crease straight in natural length (up to IV^{th} digit) and both the end of all the three creases are separated at both the ends.

For the statistical analysis chi-square test of independency was applied as the data are qualitative in nature.

IV. TRANSVERSE FLEXION CREASES



V. RESULT AND DISCUSSION

The tables related to inheritance, twins zygosity and ethnic variations are presented in the following manner :

Table : 1. Statistical analysis of inheritance of transverse flexion creases of father's vs. male offsprings. Father's right and left hand Vs. son's right and left hand

S.no.	Father Vs. son	Chi-square test of independency df=6 ; p=0.05
1.	Father Rt Vs. son Rt	χ^2= 4.72 (insignificant)
2.	Father Rt Vs. son Lt	χ^2= 4.04 (insignificant)
3.	Father Lt Vs. son Rt	χ^2= 1.32 (insignificant)
4.	Father Lt Vs. son Lt	χ^2= 1.74 (insignificant)
5.	Father Rt + Lt Vs. son Rt + Lt	χ^2= 2.6 (insignificant)

Rt- Right hand, Lt – Left hand, *df-degree of freedom, *p- Level of significant

Table 1 shows statistical analysis of inheritance patterns of transverse flexion creases in terms of fathers vs. male offspring. It could be seen from the table that all the male offsprings exhibits insignificant chi-square value. It means that the frequency of palmar transverse flexion creases of father's and male off springs are more or less same.

It may be concluded from the table that transverse flexion creases are inherited from father to their male offsprings clearly.

Table: 2. Statistical analysis of inheritance patterns of transverse flexion creases of mothers vs. male off springs. mothers right hand and left hand Vs. son's right hand and left hand

S.no.	mother Vs. son	Chi-square test of independency df=6 ; p=0.05
1.	Mother Rt Vs. son Rt	χ^2= 1.44 (insignificant)
2.	Mother Rt Vs. son Lt	χ^2= 3.26 (insignificant)
3.	Mother Lt Vs. son Rt	χ^2= 1.14 (insignificant)
4.	Mother Lt Vs. son Lt	χ^2= 0.82 (insignificant)
5.	Mother Rt + Lt Vs. son Rt +l Lt	χ^2= 1.26 (insignificant)

Rt- Right hand, Lt – Left hand, *df-degree of freedom, *p- Level of significant

Table2 shows statistical analysis of inheritance patterns of transverse flexion creases in terms of mothers and male off springs. It could be observed from the table that all the male offsprings exhibits insignificant chi-square value. It means that the frequency of palmar transverse flexion creases of mothers and male off springs are more or less same.

It may be concluded from the table that transverse flexion creases are inherited from mother to their male off spring.

Table: 3. Statistical analysis of inheritance of transverse flexion creases of father's vs. female offsprings. Father's right hand and left hand vs daughter's right hand and left hand

	Father Vs. daughter	Chi-square test of independency df=6 ; p=0.05
1.	Father Rt Vs. daughter's Rt	χ^2= 2.39 (insignificant)
2.	Father Rt Vs. daughter's Lt	χ^2= 4.01 (insignificant)
3.	Father Lt Vs. daughter's Rt	χ^2= 1.97 (insignificant)
4.	Father Lt Vs. daughter's Lt	χ^2= 5.64 (insignificant)
5.	Father Rt + Lt Vs. daughter's Rt + Lt	χ^2= 4.56 (insignificant)

Rt- Right hand, Lt – Left hand, *df-degree of freedom, *p- Level of significant

Table 3 shows statistical analysis of inheritance patterns of transverse flexion creases in terms of fathers and female offsprings. It could be observed from the table that all female offsprings exhibit insignificant chi-square value. It means the frequency of palmar transverse flexion creases of fathers and female offsprings are more or less same.

It may be concluded from the table that transverse flexion creases are inherited from father to their female offspring.

Table: 4. Statistical analysis of inheritance of transverse flexion creases of mothers vs. female offsprings. Mothers right hand and left hand Vs. daughter's right hand and left hand

S.no.	mothers Vs. daughter	Chi-square test of independency df=6 ; p=0.05
1.	Mother Rt Vs. daughter's Rt	χ^2= 3.47 (insignificant)
2.	mother Rt Vs. daughter's Lt	χ^2= 1.47 (insignificant)
3.	mother Lt Vs. daughter's Rt	χ^2= 1.55 (insignificant)
4.	Mother Lt Vs. daughter's Lt	χ^2= 0.58 (insignificant)
5.	Mother Rt+ Lt Vs. daughter's Rt +Lt	χ^2= 2.04 (insignificant)

Rt- Right hand, Lt– Left hand, *df-degree of freedom, *p- Level of significant

Table 4 shows statistical analysis of inheritance patterns of transverse flexion creases in terms of mothers and female off springs. It could be observed from the table that all the female offsprings exhibit insignificant chi-square value. It means the frequency of palmar transverse flexion creases of mothers and female offsprings are more or less same.

It indicates that transverse flexion creases are inherited from mother to their female off spring.

Table: 5. Concordance and dis-concordance among di-zygotic and mono zygotic twins.

Twins	No.	Side	Concordance		Dis-concordance	
			Ab	Pc	Ab	Pc
Mono-zygotic twin (MZ)	54	Rt	46	85.19	8	14.81
		Lt	42	77.78	12	22.22
		Rt+Lt	88	81.48	20	18.52
Di-zygotic twins (DZ)	72	Rt	52	72.22	20	27.78
		Lt	48	66.67	24	33.33
		Rt+Lt	100	69.44	34	30.56

* Ab : Absolute number,* Pc : Percentage

The table 5 shows concordance and dis-concordance among DZ twins and MZ twins. It could be observed from the table that MZ twins show 85.19 % concordance and 14.81 % dis-concordance in right hands, while the DZ twins show 72.22% concordance and 27.78% dis-concordance in right hands. The left hands of MZ twins show 77.78% concordance and 22.22% dis-concordance, while DZ twins show 66.67% concordance and 33.33% dis-concordance among left hands.

While considering Right and left hands (Rt+Lt) both, it is observed that MZ twins show 81.48% concordance and 18.52% dis-concordance, while the DZ twins shows 69.44% concordance and 30.56% of dis-concordance. The results are clearly showing that the MZ twins have more similarities as compared to DZ twins.

It could be summarized from the table that the transverse flexion creases are heritable traits.

Table : 6. Concordance and dis-concordance among di-zygotic twins of like sex and unlike sex

Twins	No.	Side	Concordance		Dis-concordance	
			Ab	Pc	Ab	Pc
Di-zygotic twins like sex	48	Rt	34	70.83	14	29.17
		Lt	30	62.50	18	37.50
		Rt+Lt	64	66.67	32	33.33
Di-zygotic twins unlike sex	24	Rt	16	66.67	8	33.33
		Lt	14	58.33	10	41.67
		Rt+Lt	30	62.50	18	37.50

* Ab : Absolute number,* Pc : Percentage

The table 6 shows concordance and dis-concordance among like sex and unlike sex of DZ twins. It could be observed from the table that DZ twins of like sex show 70.83% concordance and 29.17% dis-concordance in right hands, while the DZ twins of unlike sex show 66.67% concordance and 33.33% dis-concordance in right hands. The left hands of like sex of DZ twins show 62.50% concordance and 37.50% dis-concordance, while DZ twins of unlike sex show 58.33% concordance and 41.67% dis-concordance in left hands.

While considering both the hands (Rt+Lt), it may be observed from the table that DZ twins of like sex show 66.67% concordance and 33.33% dis-concordance, and DZ twins of unlike sex show 62.50% concordance and 37.50% dis-concordance.

Table: 7. Showing ethnic variation of transverse flexion creases among Brahmins and Kacchis right hands of males.

S.no.	Crease types	Bhrahmins males Rt hand		Kacchis males Rt hand	
		Ab.	Pc.	Ab.	Pc.
1.	TFC I	10	6.67	5	3.33
2.	TFC II	15	10.00	6	4.00
3.	TFC III	0	0.00	0	0.0
4.	TFC IV	17	11.33	14	9.33
5.	TFC V	2	1.33	9	6.00
6.	TFC VI	16	10.66	40	26.67
7.	TFC VII	10	6.67	13	8.67
8.	TFC VIII	11	7.33	1	0.67
9.	TFC IX	8	5.33	13	8.67
10.	TFC X	20	13.33	19	12.67
11.	TFC XI	32	21.33	23	15.33
12.	TFC XII	0	0.0	0	0.0
13.	TFC XIII	1	0.67	2	1.33
14.	TFC XVI	5	3.33	3	2.00
15.	TFC XV	3	2.00	2	1.33
Total		**150**	**99.98**	**150**	**99.99**

* Ab : Absolute number,* Pc : Percentage,*Chi-squqre χ^2 =35.32, df 14, P < 0.05 (Significant)

Table 7 shows frequency related to transverse flexion creases among Brahmin and Kacchis right hands of males. It may be observed from the table that the highest frequency is shown by TFC XI type of crease among Brahmins, while kacchis show highest frequency of TFC VI. The chi square value shows significant value. It means, there is clear cut ethnic variation in the frequency of transverse flexion creases of Brahmin and Kacchis. It indicates the ethnic variation among the frequency of transverse flexion creases of Brahmins and Kacchis.

Table: 8. Showing ethnic variation of transverse flexion creases among Brahmin and Kacchis left hands of males.

S.no.	Crease types	Bhrahmins males Lt hand		Kacchis males Lt hand	
		Ab.	Pc.	Ab.	Pc.
1.	TFC I	9	6.00	5	3.33
2.	TFC II	9	6.00	14	9.33
3.	TFC III	1	0.66	0	0
4.	TFC IV	14	9.33	9	6.00
5.	TFC V	8	5.33	6	4.00
6.	TFC VI	20	13.33	23	15.33
7.	TFC VII	13	8.67	16	10.67
8.	TFC VIII	5	3.33	2	1.33
9.	TFC IX	15	10.00	19	13.67
10.	TFC X	20	13.33	18	12.00
11.	TFC XI	30	20.00	30	20.00
12.	TFC XII	2	1.33	0	0
13.	TFC XIII	1	0.67	3	2.0
14.	TFC XVI	1	0.67	2	1.33
15.	TFC XV	2	1.33	3	2.00
Total		150	99.98	150	99.99

* Ab : Absolute number,* Pc : Percentage,* Chi Square χ^2 =11.81, df 14, P < 0.05 (Insignificant)

Table 8 shows frequency of transverse flexion creases among Brahmin and Kacchis left hands of males. It may be observed from the table that the highest frequency is shown by TFC XI type of crease among Brahmins, kacchis show highest frequency of TFC XI. Chi square value shows insignificant value. It shows clearly ethnic

variation in the frequency of transverse flexion creases of Brahmin and Kacchis. It denotes the ethnic variation among Brahmins and Kacchis.

Table: 9 . Showing ethnic variation of transverse flexion creases among the Brahmin and Kacchis both (right+left) hands of males.

S.no.	Crease types	Bhrahmins males Rt+Lt hands		Kacchis males Rt+Lt hand	
		Ab.	Pc.	Ab.	Pc.
1.	TFC I	19	6.33	10	3.33
2.	TFC II	24	8.00	20	6.67
3.	TFC III	1	0.33	0	0.0
4.	TFC IV	31	10.33	23	7.67
5.	TFC V	10	3.33	15	5.00
6.	TFC VI	36	12.00	63	21.00
7.	TFC VII	23	7.67	29	9.67
8.	TFC VIII	16	5.33	3	1.00
9.	TFC IX	23	7.67	32	10.67
10.	TFC X	40	15.33	37	12.33
11.	TFC XI	62	20.67	53	17.67
12.	TFC XII	2	0.67	0	0.0
13.	TFC XIII	2	0.67	5	1.67
14.	TFC XVI	6	2.00	5	1.67
15.	TFC XV	5	1.67	5	1.67
Total		300	100.00	300	99.98

* Ab : Absolute number,* Pc : Percentage,* Chi Square χ^2 = 31.2, df 14, P < 0.05 (Significant)

Table 9 shows ethnic variation of transverse flexion creases among Brahmin and Kacchis both hands (Rt+Lt) of male. It may be observed from the table that the highest frequency is shown by TFC XI type of crease among Brahmins, while among kacchis TFC VI shows highest frequency. The Chi square value for ethnic variations among Brahmins and Kacchis males of both hands (Rt+Lt) are showing significant value. It means that ethnic variation is present in between Brahmins and Kacchis.

Table: 10 . Showing ethnic variation of transverse flexion creases among Brahmin and Kacchis right hands of females.

S.no.	Crease types	Bhrahmins females Rt hand		Kacchis females Rt hand	
		Ab.	Pc.	Ab.	Pc.
1.	TFC I	5	3.33	4	2.67
2.	TFC II	11	7.33	5	3.33
3.	TFC III	0	0.0	0	0.0
4.	TFC IV	9	6.00	21	14.0
5.	TFC V	5	3.33	7	4.67
6.	TFC VI	26	15.33	29	19.33
7.	TFC VII	11	7.33	16	10.67
8.	TFC VIII	2	1.33	2	1.33
9.	TFC IX	19	12.67	14	9.33
10.	TFC X	13	8.67	6	4.00
11.	TFC XI	23	15.33	32	21.33
12.	TFC XII	1	0.67	0	0.0
13.	TFC XIII	1	0.67	4	2.67
14.	TFC XVI	14	9.33	6	4.00
15.	TFC XV	10	6.67	4	2.67
Total		150	100.00	150	99.98

* Ab : Absolute number,* Pc : Percentage,* Chi Square χ^2 =33.01, df 14, P < 0.05 (Significant)

Table 10 shows ethnic variation of transverse flexion creases among Brahmin and Kacchis right hands of females. It may be observed from the table that the highest frequency is shown by TFC VI type of crease among

Brahmins, while among kacchis TFC XI shows highest frequency. The Chi square value for ethnic variations among Brahmins and Kacchis females show significant result. It represents ethnic variation among Brahmins and Kacchis females.

Table: 11. Showing ethnic variation of transverse flexion creases among Brahmin and Kacchis left hands of females.

S.no.	Crease types	Bhrahmins females Lt hand		Kacchis females Lt hand	
		Ab.	Pc.	Ab.	Pc.
1.	TFC I	3	2.00	7	4.67
2.	TFC II	14	9.33	3	2.00
3.	TFC III	0	0.0	0	0.0
4.	TFC IV	18	12.00	15	10.00
5.	TFC V	6	4.0	1	0.67
6.	TFC VI	14	9.33	30	20.00
7.	TFC VII	12	8.00	14	9.33
8.	TFC VIII	8	5.33	2	1.33
9.	TFC IX	23	15.33	30	20.00
10.	TFC X	13	8.67	16	10.67
11.	TFC XI	20	13.33	24	16.00
12.	TFC XII	2	1.33	0	0.0
13.	TFC XIII	0	0.0	2	1.33
14.	TFC XVI	10	6.67	3	2.00
15.	TFC XV	7	4.67	3	2.00
Total		150	99.99	150	99.99

* Ab : Absolute number,* Pc : Percentage,* Chi Square χ^2 =36.34, df 14, P < 0.05 (Significant)

Table 11 shows ethnic variation of transverse flexion creases among Brahmin and Kacchis left hands of females. It may be observed from the table that the highest frequency is shown by TFC IX type of crease among Brahmins, while among kacchis TFC VI shows highest frequency. Chi square value for ethnic variations among Brahmins and Kacchis females show significant value.

It means that ethnic variation is present in the Brahmins and Kacchis females.

Table: 12. Showing ethnic variation of transverse flexion creases among Brahmin and Kacchis both hands (right+left)of females.

S.no.	Crease types	Bhrahmins females Rt+Lt hand		Kacchis females Rt+Lt hand	
		Ab.	Pc.	Ab.	Pc.
1.	TFC I	8	2.67	11	3.67
2.	TFC II	25	8.33	8	2.67
3.	TFC III	0	0.0	0	0.0
4.	TFC IV	27	9.00	36	12.00
5.	TFC V	11	3.37	8	2.67
6.	TFC VI	40	13.33	59	19.67
7.	TFC VII	23	7.67	30	10.00
8.	TFC VIII	10	3.33	4	1.67
9.	TFC IX	42	14.00	44	14.67
10.	TFC X	26	8.67	22	7.33
11.	TFC XI	43	14.33	56	18.67
12.	TFC XII	3	1.00	0	0.0
13.	TFC XIII	1	0.33	6	2.00
14.	TFC XVI	24	8.00	9	3.00
15.	TFC XV	17	5.67	7	2.33
Total		**300**	**99.97**	**300**	**99.99**

* Ab : Absolute number,* Pc : Percentage,* Chi Square χ^2 = 40.27, df 14, P < 0.05 (Significant)

Table 12 shows ethnic variation of transverse flexion creases among Brahmin and Kacchis both hands (Rt+Lt) of females. It may be observed from the table that the highest frequency is shown by TFC IX type of crease among Brahmins, while among kacchis females TFC VI shows highest frequency. The Chi square value among Brahmins and Kacchis female both hands (Rt+Lt) combined show significant value.
It indicates that ethnic variation is found among among Brahmins and Kacchis females.
It may be concluded from the above tables that :

- All the tables (table 1^{st} to 4^{th}) related to inheritance shows insignificant value of chi square test of independency, which indicate that transverse flexion creases are inherited from parents to children.
- The tables (table 5^{th} and 6^{th}) related to mono-zygotic twins and di-zygotic show that transverse flexion creases are heritable traits and may be applied in twin zygocity.
- All the tables (table 7^{st} to 12^{th}) related ethnic variations show significant value of chi-square test. It means that transverse flexion crease are useful in the study of population variations

It may be concluded from the above discussion that the proposed new transverse flexion crease formulation is useful in the study of inheritance, twin's diagnosis, ethnic variation and may be applied in bi-manual and bisexual variations and personal identification etc.

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