

DERMATOLGLYPHIC STUDIES IN SCHIZOPHRENIA : A REVIEW

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ABSTRACT

Dermatoglyphic studies carried out in Schizophrenia have been evaluated and critically examined. Methodological errors existing in the previous studies have been pointed out and some guidelines for methodological refinements suggested and a dermatoglyphic consensus index for diagnosis has been evolved. The heterogeneous nature of schizophrenia, being a group of syndromes, has been unanimously accepted, therefore, each category should be studied separately. Further scope of this potentially fruitful area has been discussed.

In the recent past a number of investigators have focussed their attention in finding out an association of morphological and genetical characters with a number of human pathological conditions. Dermatoglyphics, determined by polygenic inheritance, are one of such tools frequently used in scientific studies. It has been demonstrated by many that dermatoglyphic analyses are of aid in the diagnosis, nosology and understanding the genetics of many human pathogenic abnormalities (Alter, 1966, Penrose, 1968, David, 1969, Stough and Seely, 1969, Verbov, 1970, Holt, 1973, Shiono and Kadowaki, 1976, Saran, 1977 and Balgir, 1982a).

Since Galton's (1892) pioneering work on finger prints a number of researchers have studied the dermatoglyphic correlates of mental and behavioural traits. Significant differences have been reported in dermatoglyphic features of various abnormal populations in Psychiatry in comparison to normal populations (Alter, 1966, Balgir et al., 1978, Balgir, 1982a and b). Dermatoglyphic delineations are most pronounced in case of populations characterized by chromosomal anomalies (Schaumann and Alter, 1976 and Bhasin et al. 1979). The use of dermatoglyphics as a genetic marker in Schizophrenia has attracted the attention

of many investigators throughout the world, i.e., Europe, America, Africa, Asia and Australia.

The accumulated dermatoglyphic data on Schizophrenic patients allow us, at present, to critically examine the various studies carried out in this direction. The following is a review which highlights the current understanding of the subject, methodological limitations of the studies and the potential scope of this fruitful area.

Dermatoglyphic studies in Schizophrenia

The earliest studies of dermatoglyphics of schizophrenia were that of Poll (1935), Moller (1935) and Duis (1937), who found that the normal sex difference was reduced in their schizophrenic sample. Poll (1935) was the first investigator to study comprehensively the finger patterns of patients with schizophrenia. He analysed the prints of a German series comprising 232 males and 545 females and compared them with a large sample of the general population. He found a lower incidence of whorls in the male schizophrenics than in the control males, while in female schizophrenics the incidence was higher than in the normal females. The usual sex differences with respect to pattern type frequency, therefore, were practically eliminated in the

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patients. Moller's (1935) results form a study of Danish schizophrenics, confirmed Poll's (1935) observations, allowing for racial differences which were apparent in both affected and control samples.

Wendt and Zeli (1951) found a sex difference in another German series of schizophrenics, but strangely not in their control group. This was the only study in which the normal male-female sex difference was not reported in the control population. The reasons for this were not clear. Pons (1959) and Raphael and Raphael (1962) investigated only males. In a Spanish sample Pons (1959) found no difference in the frequency of finger print patterns between schizophrenics and the controls. He also reported an increase in I_3 interdigital area pattern and unusual pattern in the hypothenar area in patients.

Raphael and Raphael (1962) employed rigorous criteria for the selection of schizophrenic males. They excluded all those left handed or showing any possible complicating conditions or known genetic disturbances in the patients and their families. But their use of English population figures for controls (patients were from the U.S.A.) was a serious drawback. They reported an increased frequency of whorls and arches and striking statistically significant increase in the pattern dissociations in the schizophrenics, which was rare in the general population. Similarly Beckman and Noring (1963) reported a higher frequency of whorls in schizophrenics of both sexes and an increase in arches in males. Singh (1967) had reported significant increased arches and accidentals frequency among males and whorls and ulnar loops in females. There was also a greater frequency of disrupted ridges in the patients.

Sank (1968) studying childhood schizophrenics found that they were different from the adult schizophrenics. There was also an increase in the sex differences in contrast to the 'levelling off' of sex differences

in the adults (Poll, 1935; Moller, 1935 and Duis, 1937). Rosner and Steinberg (1968) studying 207 Negro male schizophrenics found statistically significant differences in the finger and palm prints. They also reported differences among Hebephrenic, Catatonic and Paranoid sub-categories. They strongly suggested that schizophrenics were not a homogeneous group for dermatoglyphic study. Their conclusion was that there was no clinical application of the study.

Mellor (1968) tried to find reasons for the conflicting results of previous workers and had gone some way towards explaining them. In his study, he defined the diagnostic criteria, used sampling techniques and eliminated other conditions now known to be associated with variation of dermatoglyphic characters. Mellor's sample consisted of 232 male and 253 female schizophrenics of British ancestry in the age ranging from 16 to 60 years. Acute and chronic cases were included. He found statistically significant differences in both qualitative and quantitative features. The pattern frequencies of the female patients, particularly Hebephrenics, differed significantly from those of the control females, being nearer to those of the control males. No difference was apparent between normal and affected males. Palmprints of Catatonic showed an increase in I_3 interdigital patterns. The mean 'atd' angle was significantly higher in both the sexes and there was also significant difference in total ridge count between controls and male schizophrenics. In females, however, the difference between the values for affected and control groups was not statistically significant.

Mellor considered that the contradictory findings of previous workers could be explained by the relative proportions of the different schizophrenic subcategories in their total samples. The findings of all these workers could be due to a relatively large proportion of Hebephrenics in their samples. However, the results of Raphael and Raphael

(1962) with respect to male schizophrenics and those of Beckman and Norring (1963) were harder to explain. Mellor (1968) took his investigation of finger patterns a stage further by studying total finger ridge count in the schizophrenics. For control he used Holt's (1955) data. Holt (1972) commented that Mellor's (1968) ingenuity in finding at least a partial explanation for the diverse and conflicting findings of previous workers with regard to the frequencies of finger patterns was highly commendable. He demonstrated that variation in pattern frequency was associated with schizophrenic sub-categories.

Lucas and Lehenbecher (1969) in their attempt to screen cytogenetically the new-born offsprings of schizophrenic women, studied the ridge dysplasia in 17 mothers and 14 new-born children. It was noted that 9 mothers showed typical ridge dysplasias, while 6 out of 14 children showed similar abnormality. Polednak (1972) studying Negro schizophrenics found findings similar to Rosner and Steinberg (1968).

Rothhammer et al. (1971) keeping in view the methodological limitations of the previous studies, analysed the dermatoglyphics of 47 male and 50 female schizophrenics in Chile. They found significant difference in 'atd' angle between the male controls and schizophrenics. The schizophrenic females showed significant variation for total ridge count, pattern intensity, 'atd' angle and asymmetry index. On the basis of small sample size they concluded that no particular dermatoglyphic features characterize schizophrenia. Dermatoglyphics cannot be used either as an auxiliary tool for the evaluation of the role of genetic factors in the aetiology of this mental disorder or as a diagnostic instrument. Similar views had been expressed by Kemali et al. (1972, 1976).

All these comparative accounts have resulted in inconclusive and contradictory

findings. Both the reviews done by Mellor (1968) and Wendt et al. (1971) on this subject had attributed this confusing situation to the heterogeneity of schizophrenia, ethnic and geographic variations in finger print pattern frequencies and sampling methods for disagreement between the reported results.

Recent studies have applied more complex multivariate statistical techniques in dermatoglyphic comparisons between normal and abnormal populations. In multivariate statistical comparisons, several variables are considered simultaneously. Thus, several small differences between populations, no one of which is statistically significant, may be quite significant when considered in combination. Stowens et al. (1970) conducted a comparative dermatoglyphic study of 82 hospitalized schizophrenics and 295 normal controls. All of the subjects were adult, female and white. Twenty-three different dermatoglyphic variables on each hand were included in the investigation. Using the multivariate statistical technique of discriminant analysis, 82 percent of the schizophrenic sample could be distinguished from the control sample on the basis of totality of dermatoglyphic features. The dermatoglyphic variables which contributed most to the discrimination between the two groups were : the higher frequency of abnormal palmar creases, the increased frequency of arches, the deficiency of the main line C of some degree and the decreased frequency of radial loops on the index finger among the schizophrenic sample. Similarly Singh (1975) omitted the discriminant functions of whorls and arches and found that the main contribution came from the ridge counts of individual fingers in both hands.

Recently Maricq (1979) has used the plexus visualization score (PVS) ratings for finger-prints of schizophrenics. The finger-print data on 242 schizophrenics selected on the basis of both their ethnic origin and

PVS ratings have demonstrated a significant difference in the frequency of whorls between high PVS and low PVS schizophrenics. The author has pointed out that the value of finger-print study lies not in defining a particular pattern for schizophrenics or for their subgroups, but it gives support to the hypothesis that PVS may be a useful biological indicator in schizophrenia research. However, the confirmation of these findings is called for.

From India, Biswas and Bardhan (1966) found more abortive C-lines, pearl lines and simian creases among the schizophrenics than the control population. Bali (1971) also found a significantly higher frequency of single radial base crease (SRBC) and lower frequency of double radial base crease (DRBC) among the patients. Dasgupta et al. (1973) have reported a detailed study on 300 male and 300 female schizophrenics with a similar number of controls belonging to Tamil Nadu. In their study, they found difference in finger patterns, palmar patterns and axial triradius. The limitations of this study were : (i) only qualitative features were studied except for axial triradius, (ii) the criteria for selection of patients was not clear, (iii) the schizophrenics were a heterogeneous group and no separate study was made of the sub-categories, (iv) the total ridge count, having the greater relevance for genetic study of dermatoglyphics (Holt, 1961) was not studied and (v) the controls were not strictly from the same ethnic group (belonging to the identical geographical areas).

Eswaraiah (1978) studied the palm-prints of 118 male schizophrenics and compared with 536 normals. The high frequency of single radial base crease (SRBC), other main lines, absence of C-lines were observed among the schizophrenics as compared to normal population. His findings were similar to Biswas and Bardhan (1966) and Bali (1971).

Karmakar and Malhotra (1980) studied

both the qualitative and quantitative palmar dermatoglyphic traits of 61 male and 51 female schizophrenics of age 20 to 50 years and compared with normal controls of 50 of each sex. Both the sexes of normal and schizophrenics revealed significant differences in a-b and c-d ridge counts, 'atd' angle and simian crease types. The male schizophrenics also showed significant differences compared to normal males in b-c ridge count, position of axial triradius and incidence of pearl line. This study also had the similar limitations as mentioned above.

Recently Ponnudurai (1981) compared the dermatoglyphic variations between 100 male schizophrenics and the same number of normals from Madras. He matched both control and diseased group with respect to age, sex and ethnic background and found a marginal difference between the schizophrenics and normals on the qualitative aspect. Among the digital patterns, there was a tendency for the whorls to appear less frequently on the left first digit among schizophrenics and the percentage frequency of arch pattern on left digits was greater among them. However, the ridge counts and 'atd' angle were not significant. This study dealt with only the male schizophrenics.

All the above studies from India had the serious drawback that they did not realize the heterogeneous nature of schizophrenia but considered a single disease entity rather than a group of syndromes.

To overcome the commonly occurring methodological errors, the following guidelines have been suggested :

1. *Diagnosis* : All the investigators have not specified the criteria of diagnosis and utilized the standard diagnostic system. A loose approach to diagnosis leads to 'impure' sample and can lead to erroneous findings.

2. *Controls* : The natural variations among general population of different ethnic groups call for certain special efforts to

include controls belonging to the same ethnic groups as the patients. Some of the criteria for homogeneity are the geographical place or residence, religion and caste. If the samples or controls are heterogeneous in this aspect the differences can disappear or wrong findings can be noted.

3. *Size of the sample* : The variations of dermatoglyphic features are such that unless large numbers are studied the findings are likely to be limited. An ideal size of the sample is more than 100 of each subcategory or illness group.

4. *Sex representation* : Dermatoglyphics show sexual dimorphism. If the pattern frequencies of both male and female patients are pooled together, then it becomes difficult to say whether the difference actually exists in males or females. For clarification patients should be studied sex-wise.

5. *Subcategories of schizophrenia* : Latest knowledge warrants the heterogeneous nature of schizophrenia. It is, therefore, essential to study each category of schizophrenia separately. Dermatoglyphics of schizophrenic subcategories grouped together, exaggerate the findings because of unequal representation of each category.

6. *Indices of analysis* : Most of the investigators use different methodologies for the study of dermatoglyphics. Most of them study only the qualitative dermatoglyphic features. Different methodologies and incomplete analysis pose difficulties in comparing the findings of various investigators. (Table 1).

In addition, most investigators report only for the three finger print patterns (arches, loops and whorls), while others split them into five or more groups (Singh, 1967). There is also wide variation in what is referred to as 'ridge dissociations' (Raphael and Raphael, 1962 ; Beckman and Norring, 1963) and ridge dysplasias (Lucas and Lehrenbecher, 1969). Similarly some authors report pattern frequencies (Raphael

and Raphael, 1962 ; Beckman and Norring, 1963 ; Mellor, 1968 ; Sank, 1968) while others describe the differences in the frequencies for each finger (Singh, 1967 ; Dasgupta *et al.* 1973 ; Ponnudurai, 1981). All this has added to the confusion and controversies and difficulties in comparing the findings of one investigator with another.

Finally, there is a need for dermatoglyphic investigations which incorporate the currently known genetic knowledge of schizophrenia (independence, subcategories and relevance of family history) and overcome the above listed limitations.

Following the above guidelines Srinivasa Murthy (1975) compared the dermatoglyphics of 240 (120 males and females each) schizophrenics with the same number of controls. The sample consisted of ethnically similar groups (based on parentage, residence, religion and ethnic background and caste in North India. Only those patients with clear-cut clinical picture and whose diagnosis was not in doubt were included. The schizophrenics belonged to four sub-categories, 30 each, namely Acute schizophrenic episode, Cataleptic, Paranoid and Chronic undifferentiated, classified according to the criteria in APA-DSM-II (1968). Normal subjects, having any known family history of mental illness or of other congenital or hereditary illnesses were excluded from the study. These normal subjects were not related to each other or to the patients. He also tried to find out the relationship between positive family history of schizophrenia and dermatoglyphic features as this was not done before. The presence or absence of a family history of schizophrenia was ascertained by detailed interview of family members and cross-checking of the clinical records. Patients with relatives having other psychiatric illnesses were excluded.

It was found that the schizophrenics and normals differed both in qualitative and

TABLE 1. *List of limitations of dermatoglyphic studies in schizophrenia*

Investigator (s)	Country	Con- trols (*)	Sex distri- bution	Diag- nostic criteria	Sub- categories studied	Family his- tory	Limita- tions (**)
Poll (1935)	.. Germany	A	M+F	INA	NS	NS	1
Moller (1935)	.. Denmark	A	M+F	INA	NS	NS	1
Duis (1937)	.. Prussia..	NC	M+F	INA	NS	NS	1, 2
Wendt & Zell (1951)	.. INA ..	A	M+F	INA	NS	NS	1
Pons (1959)	.. INA ..	A	M	INA	NS	NS	1
Raphael & Raphael (1962)	.. USA ..	IA	M	YES	NS	NS	3
Beckman & Norring (1963)	.. Sweden	A	M+F	YES	NS	NS	1
Biswas & Bardhan (1966)	.. India ..	A	M+F	INA	NS	NS	1, 4
Singh (1967)	.. Australia	A	M+F	YES	NS	NS	4
Sank (1968)	.. USA ..	A	M+F	YES	NS	NS	1
Rosner & Steinberg (1968)	.. USA ..	A	M	YES	NS	NS	1
Mellor (1968)	.. UK ..	A	M+F	YES	YES	NS	..
Lucas & Lehrenbecher (1969)	USA ..	NC	F	YES	NS	Yes	1, 5
Stowens <i>et al.</i> , (1969)	.. INA ..	A	F	INA	NS	NS	4
Zavala & Nunez (1970)	.. INA ..	A	M	INA	INA	NS	5
Miketsaar (1971)	.. Russia	INA	M+F	INA	INA	NS	5
Rothhammer <i>et al.</i> , (1971)	.. Chile	A	M+F	YES	NS	NS	5
Bali (1971)	.. India ..	A	M	NO	NS	NS	1, 4
Polednak (1972)	.. USA ..	A	M	Yes	NS	NS	1, 5
Kemali <i>et al.</i> , (1972)	.. Italy ..	IA	M	Yes	NS	NS	5
Dasgupta <i>et al.</i> , (1973)	.. India ..	IA	M+F	NO	NS	NS	1
Srinivasa Murthy (1975)	.. India ..	A	M+F	YES	YES	YES	..
Kemali <i>et al.</i> , (1976)	.. Italy ..	A	M	YES	NS	NS	..
Eswaraiah (1978)	.. India ..	IA	M	NO	NS	NS	1, 4
Maricq (1979)	.. U.S.A.	A	M	YES	NS	NS	..
Karmakar and Malhotra (1980)	India ..	IA	M+F	NO	NS	NS	5
Ponnudurai (1981)	.. India ..	A	M	Yes	NS	NS	..

*A=Adequate, NC=No controls, IA=Inadequate controls, INA=Information Not available (foreign language references). NS=Not studied, M=Males, F=Females.

**1. Qualitative study only, 2. No controls, 3. Control from different ethnic group. 4. Ridge count not studied, 5. Small number of patients studies (less than 50).

quantitative features (Srinivasa Murthy and Wig, 1977a). Male schizophrenics had increase in arch pattern frequency and a decrease of whorl frequency in comparison to controls. Palmar patterns were also different in schizophrenics and normals. Frequency of patterns in I² and I³ interdigital areas was significantly lower in schizophrenics than in the normals. These findings of Srinivasa Murthy and Wig (1977a and b) have been supported by other investigators as well (Maricq, 1979 and Ponnudurai, 1981). Further analysis of the data for the subcategories showed that the four sub-categories were significantly different in dermatoglyphic feature, though all the quantitative differences were not significant. It was noted that there was a tendency for movement towards the opposite sex as noted by Sank (1968).

Dermatoglyphics in schizophrenia also showed the relevance of positive family history (Srinivasa Murthy and Wig, 1977b). In males the frequency of arches was 2.25 per cent, 3.41 per cent and 6.57 per cent in normals, schizophrenics without family history and those with such history, respectively. The difference in total finger ridge count between those with family history and without family history was approaching significance in males (128.500 vs 142.525). A 'levelling off' of the sex difference was noted among schizophrenics for the total finger ridge counts. The differences noted between schizophrenics with and without a positive family history was the accretion of the noted differences between normals and schizophrenics.

These findings supported the view of studying schizophrenia as a syndrome and not as a single disease entity for intensive study. Studies to correlate changes in androgyny and dermatoglyphic features were called for as 'levelling off' of the sex differences have been reported for this measure too.

Dermatoglyphic studies pertaining to

the subcategories of schizophrenia are few. There are only three published reports (Rosner and Steinberg, 1968, Mellor, 1968 and Srinivasa Murthy and Wig, 1977a) available at present where the dermatoglyphics have been studied for each category separately. On the basis of this meagre data, it is difficult at the moment to draw definite inferences from them, rather it is likely to arrive at fallacious conclusions.

In general when the dermatoglyphics of schizophrenics as a group were compared with normal controls then most of the studies show common following salient findings: increase of arches and loops and decrease of whorls (or composite patterns), increase of Dankmeijer's index and decrease of Furuhashi's index and pattern intensity index, decrease of patterns in the interdigital areas except I³, increase in the frequency of pattern dissociation, higher incidence of absence of C-line termination and presence of simian crease, larger 'atd' angle, reduction in interdigital triradius ridge counts and total finger ridge counts among the schizophrenics as compared to the normal controls.

Schizophrenia and other disorders

Walker (1956) was the first who suggested an association between mongolism and schizophrenia. She observed within parent-child and sib-sib relationships, an association between mongols and schizophrenics and in all these cases, the mongols had indices lying in the overlap area. She then studied two families with mongol and schizophrenics within the same sibship and noted that a general similarity in dermal configurations existed between the mongols and their schizophrenic brothers in each family. She explained that the similarity in the dermal configurations of mongols and schizophrenics suggested that there was a disturbance of early foetal growth in these schizophrenics similar to that occurring in mongols.

Raphael and Shaw (1963) conducted certain chromosomal studies in schizophrenia and suggested that specific abnormalities of the sex chromosomes were more frequent among schizophrenia or schizophrenic-like disorders, mental processes, etc. which occurred in parents with chromosomal anomalies. They also made the point that if mental illness and chromosomal disorders involving the sex chromosomes as well as autosomes are influenced by the same factors, then there should be an increased frequency of leukaemia, Mongolism, Mosaicism, double aneuploidy and translocation.

Mellor (1968) also noted the similarities between Catatonic schizophrenia and Mongolism on the basis of both qualitative and quantitative dermatoglyphic features. Singh (1975) also found some similarities between mental retardation and schizophrenia. These findings are fascinating, but further dermatoglyphic as well as other cytogenetic studies are needed before any conclusive evidence is obtained.

Sank (1968) studied 37 girls and 49 boys ranging from 5-12 years and control group consisting 38 girls and 60 boys from the same random population and geographical area. The results of this study were strongly suggestive that childhood schizophrenia represented a dermatoglyphically different entity from adult schizophrenia and normal control population and thus might be biologically distinct from them. The study is still amenable to further analysis and eventual resolution.

Conclusions, implications and suggestions for future work

The available evidence points to the heterogeneity of schizophrenia in terms of onset, clinical symptoms, course, prognosis, family history, genetic and environmental factors and nosology. The influence of heterogeneity of schizophrenia has been partly responsible for the often conflicting findings of different investigators, i.e. genetic,

dermatoglyphic, epidemiological, biochemical and follow-up studies. At present the emphasis is being laid for co-ordinating the problem from various angles around the world. That is how the greater relevance of different factors has become clear with greater clarity and precision of the investigations. This has also been so with the dermatoglyphic studies of schizophrenia.

The significant dermatoglyphic differences noted between those with 'genetic loading' and those without such history add an additional dimension in differentiating the two groups. These differences in the dermatoglyphics, being 'genetic markers' raise the possibility of detecting those who are predisposed to develop schizophrenia. For any such success, it would be essential to employ larger number of controls and patient population with strict criteria of identification and classification for schizophrenics. It is unlikely that a single feature would show the possible schizophrenic tendency but a cluster of features would certainly act as an adjunct to diagnosis.

The association of schizophrenia with other conditions of similar dermatoglyphics has also been suggested. The evidences are fairly available showing overlap of abnormalities of schizophrenia and mongolism (Earl, 1934 ; Rollin, 1946 ; Walker, 1956 and Mellor, 1968). Singh (1975) found some similarities between mental retardation and schizophrenia. Recently Balgir *et al.* (1980) have found dermatoglyphic differences between manic-depressive psychosis and schizophrenia which support that these two psychoses are genetically distinct. These findings are fascinating to warrant further dermatoglyphics as well as karyotype studies, before any conclusive evidence is obtained.

It will be necessary in future studies to use appropriate samples of the schizophrenic population, with equal number of males and females, equal number of schizophrenics

from each subcategory [according to ICD-9 (1975) classification preferably, so that they are chosen according to the same diagnostic criteria]. With large number in each sample (at least more than 100) to compensate for wide individual variations and with controls matched according to ethnic group (including geographical areas, religion, mother tongue, caste, etc. in India), age and sex. The control should also be examined and should not have any family history of psychiatric, congenital or hereditary illness. Finally, the analysis of both qualitative and quantitative dermatoglyphics must be done.

An additional area is the anthropometric study. Most of the studies have reported a tendency for levelling off of the dermatoglyphic sex differences among the schizophrenics. In this connection the changes in androgyny (the value arrived at by measuring the biacromial and bi-iliac diameters) are of interest. Mayer-Gross *et al.* (1969) raise the possibility of this anthropometric feature which is likely to have correlation with traits of temperament. Studies to correlate changes in androgyny and dermatoglyphic features are needed to test such an association.

One potential area for dermatoglyphic investigation is in the area of 'disputed' schizophrenic sub-categories. Some consider schizo-affective schizophrenia to be having a complex and unclear relation to schizophrenia and affective illness (Welner and Stromgren, 1958 and Stromgren, 1965) or it being entirely independent of other entities (Mitsuda, 1965). Similarly, the atypical psychoses and borderline schizophrenia could be studied by this relatively easy and inexpensive genetic tool. Some indication of the relevance of such a study is provided by the report of Sank (1968) in the study of childhood schizophrenia. She found that 'adult and childhood schizophrenia may be genetically distinct'. This needs further confirmation.

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