REVIEW OF LITERATURE
For many years the study of dermatoglyphics has been accepted as a useful tool in the differentiation between monzygotic and dizygotic twins. Lately it has gained importance in clinical medicine as an additional clue in the diagnosis of developmental defects due to chromosomal aberrations particularly in Down's syndrome (Penrose, 1954; Walker, 1958; Saksena et al., 1966; Priest et al., 1973). Recent researches (Penrose, 1954, 1967, 1968, 1970 and 1971; Uchida and Solter, 1963; Holt, 1964, 1973; Alter, 1964; Stough and Seely, 1963; David, 1971 and Fuller, 1973) have further enhanced the scope of dermatoglyphics in medical sciences. Penrose (1965, 1967, 1968, 1970 and 1971 devised methods of dermatoglyphic analysis which were thought to be most useful both for the diagnostic purposes and for the genetical studies. He created a mathematical basis for the understanding and correct individual interpretation of dermal patterns and he called it dermatoglyphic topology (Iosech, 1973).

As the science of ridges progressed from original simple studies of fingers and palm prints to modern classification, several features came to prominence and several disease associations were studied. However, in assessing the
significance of dermatoglyphics in clinical medicine, the study of normal control population plays an important role. The importance of a good control, especially a family control was felt by Kulkarni (1973) and Sato et al. (1977, 1979a,b, 1980). Stough and Seely (1969) felt the same earlier and says" the significance of dermatoglyphics in clinical medicine is rarely if ever related to abnormal patterns, but rather to an increased or decreased frequency of normal patterns in usual places, and to unusual combinations of normal patterns."

The extensive list of diseases known to be associated at times with abnormal or unusual dermal configurations comprises both chromosomal and non-chromosomal disorders. To name some of the chromosomal disorders known to be associated with dermatoglyphics are ... trisomy-21 (Monglism or Down's Syndrome) (Cummins and Kiddo 1939; Penrose, 1954; Walker, 1953; Idem, 1949, 1954; Beckman, 1966 and Saksena et al. 1966); Trisomy-13 (Uchida et al., 1962; Gibson et al., 1963); Trisomy-15 (Uchida et al., 1962); B-Trisomy or cat cry syndrome (Warburton and Miller 1967; Shiono et al., 1977); Kline-felter's syndrome (Curtes, 1964; Alter et al., 1966); and Turner's syndrome (Holt and Lindsten, 1964). In addition there is a group of non-chromosomal disorders which comprises more than 30 clinical entities, in most of which the deviations from normal are often subtle and become evident only from the study of large series of patients (Stough and Seely, 1969).
Kelt and Linds ten (1964) reported that patients with Turner's syndrome had general tendencies in the ridge arrangement on fingers as well as on palms. It was also shown that patients with Turner's syndrome had an increased frequency of cardiovascular disorders (Lemli and Smith, 1965; Ranier-Pope et al., 1964; Dumjanova et al., 1968). Significant differences in patterns for both fingers and palm prints among various types of congenital malformations of heart and normals were reported (Hale et al., 1961; Cascon, 1964, 1965, 1968; Takashine and Yorinui, 1965; Emerit et al., 1967; Burguet and Collard, 1968; Alter and Schulenberg, 1970; Eirnholz, 1972; Scimone et al., 1976; Saksena and Kumar, 1969; Annaburne et al., 1977, 1978; Puri et al., 1977a, 1977b and Goto et al., 1977, 1979a, b; Bulusu et al., 1980).

Indeed much work has been accomplished in dermatoglyphics of CHD for the past two decades commencing from Hale et al. (1961) till date (Bulusu et al., 1980). Many studies carried out in this direction clustered or pooled together the various congenital cardiac malformations, though some have treated them separately. Among those who have tried to establish differential association are cascos (1960, 1965 and 1968), Puri et al. (1969), Alter and Schulenberg (1970) and Freus et al. (1970). A couple of studies are available on specific congenital heart disease like, Rashad and Ki (1972) and Rashad et al. (1973) studied myocardial infarction and Bulusu et al. (1980) carried out a pilot study.
of dermatoglyphics in Fallot's Tetralogy.

Attempts to compare CD and acquired heart disease in their association with dermatoglyphics were made by many researchers (Hale et al., 1961; Christensen and Nelson, 1963; Esherit et al., 1967; Saksena and Kumar, 1968; and Shiraki et al., 1976). These attempts were made in the light that development of heart and volar pads is concurrent during the fetal life (Chis and Harper, 1963; Moss and Adams, 1968; Gould, 1968 and Goto et al., 1977) and hence whatever genetic or environmental factors interfere with orderly cardiac formation may also interfere with the control of epidermal ridge patterns (Ermholz 1972). But this does not hold true for acquired heart disease conceivably, as they are acquired by the individual (extra-uterine).

The very common feature that was most often found to be associated with one or the other congenital heart lesion is the tendency of distal displacement of axial triradius (Hale et al., 1961; Fried and Neel, 1962; Cascos, 1965; Takashina and Yokoi, 1966; Esherit et al., 1967; Bargent and Collard, 1968; Ceccarelli et al., 1968). Alter and Schulenberg (1970) noted that patients with ventricular septal defect, patent ductus arteriosus, Tetralogy of Fallot and Multiple defects had 214 angles which were significantly wider than controls. Otherwise, he found that CD group and normal group to be remarkably similar in configuration.
As early as 1961, Hale et al. have made an attempt to compare the dermatoglyphics of patients with CHD and patients with acquired heart disease. They have not attempted to single out any specific type of congenital cardiac malformation nor the patients with other congenital diseases other than those of cardiovascular system were excluded. They have reported the distal displacement of axial triradius as well as a tendency towards multiple axial triradii in CHD patients, irrespective of the ethnic groups. A comparison was made between blacks and whites. Though statistical analysis was not carried out, Hale et al. reported that true patterns were more frequent in thenar and hypothenar areas.

In a similar study Takashina and Yorifuji (1966) attempted to determine differences of palmar patterns between normal Japanese and whites. They did not, however, single out any particular type of cardiac lesion. There was no significant difference in the position of axial triradii between normal white and Japanese subjects was observed, but found a significant departure primarily in patients with CHD, racial factors being ruled out. This is by far a big step in attempting to answer the question as to how much racial factors play their roles in forbidding dermatoglyphics to be a diagnostic tool.

Yet another study wherein a comparison has been made between CHD and acquired heart disease as control was due to Emerit et al. (1967). Differentiating between different types
of congenital malformations of heart has not been considered important, though patients with associated malformations and isolated heart disease were studied separately. A tendency towards the distal displacement of axial triradius was observed in both patients with multiple malformations and in patients with isolated heart disease when compared to normals. The deviation was found to be significant. It was also observed that the t° position of axial triradius is more frequent in the group of patients with multiple malformations, and tends to be associated more often with ventricular septal defect, patent ductus arteriosus, Fallot's tetralogy, atrial septal defect, aortic stenosis and coarctation of the aorta. A less frequent occurrence of arches in patients with isolated heart diseases than in controls and in patients with multiple malformations. Simian crease was found to be frequently associated with malformed patients than in controls but it was not found to be statistically significant in patients with isolated heart disease. A more frequent occurrence of hypothenar patterns has also been observed in patients when compared to controls. Weninger et al. (1966) on the contrary, found no significant increase in hypothenar patterns in all CHDs as compared to controls.

Christensen and Nelson (1963) obtained significant values for distal or multiple axial triradii in CHD as compared to that in acquired heart disease. Earlier Fried and Neel (1962) in their brief report commented on the higher
frequency of wide atd angles and distal axial triradii in patients with CHD.

Cascos in his conclusive work (1964, 1965, 1968) obtained statistically significant differences between the patients as a whole and normal control group and what is more interesting is he had obtained statistically significant differences between differences diagnostic groups in the series. Ulnar loops were reported to be dominant in all congenital heart groups as well as in the control group. Radial loops are more frequent in ASD but less common in Pulmonary Stenosis (PS) and Aortic stenosis. Whorls were supposed to be frequently associated with TOF and arches with PS whorls are also shown to be frequently associated with AS and CA. Cascos (1965) has also obtained significant distal displacement of axial triradius in Tetralogy of Fallot. However, Kontras et al. (1965) found that about 50-80% of congenital heart patients had the proximal positioning of axial triradius. Like Cascos (1965), they have also found radial shift of the axial triradius, but in TOF an ulnar shift was noticed in 39% of the patients. They have not observed any difference in dermatoglyphic features of control and patients with AS, PS and CA.

Studying the PDA patients Durquet and Collard (1968) and Alter and Schulenberg (1970) independently observed a significant reduction in the a-d-t ridge count on the palm of the patients. Ceccarelli et al. (1969) obtained significant
differences in a-b ridge counts between normal male subjects and male subjects of the same age with CHD. The difference between patients with congenital heart disease and normal subjects of both sexes is also significant.

Burcuuet and Collard (1968) have also reported a distal displacement of the axial triradius in CHD, significantly more common in patients with VSD or PDA. A couple of years later, the same results were reaffirmed by Burguet ef al. (1970). Ceccarelli ef al. (1968) have also noted a tendency towards the distal displacement of axial triradius but their study failed to confirm that hypothenar patterns of the patients differ from those of normal contrary to the results of Emerit ef al. (1967). Alter and Schulenberg (1970) report a non-significant increase.

David (1969) concluded that familial CHD shows a great preponderance of arches. This conclusion he based on his study of 8 cases with pulmonic stenosis out of which, in two cases the first degree relatives were affected. And he contends that there is no evidence to suggest that fingerprint can be of use to diagnose PS from these or any other figures. But Reyes (1969) from his study of 13 cases of CHD found that his observations agree with the hypothesis that in CHD, the dermatoglyphics deviate from the normals. He obtained a significant increase in the number of ulnar loops in patients with VSD. A distal displacement of axial
triradius was noted. The total ridge count was reported to be less than in normal control subjects.

But a significantly low incidence of ulnar loops and significant incidence of whorl in the groups of CHD was reported by Paci et al. (1969). This was found to be more frequent in AS, TOF and VSD whereas PDA showed significantly lower frequency of ulnar loops and a greater frequency of arches when compared to normal control. Whorls are reported to be associated with TOF also by Cascos (1964), Birnholz (1972), Bulusu et al. (1980); whereas, Weninger et al. (1966) reported increased whorls but decreased arches for 15 male patients with congenital heart disease.

In his pilot study of the hypothesis that particular dermatoglyphics are associated with specific cardiac anomalies, Birnholz (1972) observed that the TOF group is associated with more of whorls than in the normal control and the rest of CHD had fewer whorls per hand than the control group. His results were in agreement with the earlier studies of Cascos (1964). Increased frequency of hypothenar patterns in CHD when compared to normal control and a preferential increase of whorls on the middle, ring and small fingers of the left hand and ring finger of the right hand was observed.

Pushad and Mi (1973) noted a significantly higher a-b ridge count in patients with myocardial infarction than others in a sample of aged Japanese men. They have also noted an increased frequency of true whorls in conjunction with a
proportional decrease in the frequency of ulnar loops. Later in a follow up study Rashad et al. (1978) found that the trend was almost the same as in their earlier study (1973). The prominent observations in myocardial infarction being presence of true whorls and ulnar loops on the right hand, a proportional increase of twin loops was found approximately same on both hands. However, the differences between normals and CHD observed, were not statistically significant.

Significantly wider and angles were obtained in patients with VSD, PDA, TOF and Multiple defect by Alter and Schulenberg (1979). Otherwise they have found that CHD group and normal group to be remarkably similar in dermatoglyphic configurations.

Though PDA showed a decrease in whorls and an increase in arches, so also FS had an increase in arches of which the later observation agrees with Casco (1964), Preus et al. (1979) contends that this is not adequate for dermatoglyphics being an important tool in diagnostic purposes. They found no significant differences in finger patterns in cases with TOF, transposition of great vessels, VSD, ASD and Coarctation of Aorta. They did not observe any significant difference in frequency of bilateral simian crease in CHD either. This confirms the earlier studies by Emerit et al. (1967) who found no significant increase in simian creases in their patients with isolated CHD. In the combined series there is also no significant increase in bilateral simian creases.
Burgue and Collard (1968); Alter and Schulenberg (1970) also report no significant differences in the frequency of simian crease. However, Preus et al. (1970) observed a tendency towards distal displacement of axial triradius of TUF and also a highly significant increase in hypothenar patterns in cases of PS, AS and transposition of great vessels.

Attempting to evaluate the dermatoglyphic features in CHD and Turner's syndrome in Indian Children, Saksena & Kumar (1968) did not observe any significant deviation of fingerprint patterns (Ulnar loops, radial loops and whorls) between normal and CHD, excepting for the less frequent occurrence of arches in congenital heart patients. Frequent occurrence of ulnar loops and less frequent occurrence of radial loop was in agreement with Cascos (1969). Not much significance could be attached to the presence of interdigital patterns since they are found to be highly frequent in both patients and normal control as well as in the acquired heart disease. True patterns were twice as common than in control series and also twice as frequent as in acquired heart disease. Thus the study by Saksena and Kumar (1968) presents a contrast picture to that of Hale et al. (1961), and the study on Japanese population by Takashina and Torifugi (1966). A significant distal displacement of axial triradius and presence of multiplicity of axial triradii has also been noted in patients with CHD. This was thrice more frequent than in patients with acquired heart disease. Obviously the atd angle was greater as compared to the control groups.
Goto et al. (1977, 1979a, b) in their series of studies on quantitative analysis of dermatoglyphics, devised a method of obtaining the normal range of dermatoglyphic patterns, and thus knowing the degree of deviation from the normal of the dermatoglyphics of various disease states. However, his results cannot be compared with the other works since this pattern of analysis is different from those of the others. But however, from their results it may be speculated that the patients whose dermatoglyphics deviate from the normals have genetic loads. They have also reported (1977) that in the mother of the patient with CHD had the genetic load by the analysis of the TRC. Cascos (1968) in his familial dermatoglyphic survey found that the dermatoglyphic traits were more like their mothers than their fathers. He speculated that a genetically determined fraction is present amongst all the patients with CHD. Goto et al. (1977) reported that the total ridge counts of children with CHD, their fathers and their mothers were compared with each other and with that of the controls. Total ridge count of the children and the mothers were significantly lower than that of the fathers and the controls.

In India apart from Saksena and Kumar (1969) and Cimeni (1976), Annapurna et al. (1975, 1977), Puri et al. (1977a, b), Kulkarni (1979) have attempted to investigate dermal peculiarities in congenital heart diseases, of whom Kulkarni considered a family control as the best.
Annapurna et al. (1975) obtained a significant increase in the frequency of arches and decrease in the frequency of whorls in ASD; Similar results were earlier obtained by Preus et al. (1970) and Cascos et al. (1969). Annapurna et al. (1975) have also noted a significant increase in the frequency of whorls and considerable decrease in the frequency of ulnar loops among the patients of tetralogy of Fallot (TOF) which was earlier reported by Cascos (1965, 1971). Laurenti (1969), Kntres and Bodenbender (1965) and Birnholz (1972). Similar conclusions were also reached by Bulusu et al. (1980). Magotra and Chokrabarty (1976) infer that a predominance of ulnar loops in VSD, whorls in ASD and TOF, arches in PS, and only ulnar loops in PDA have diagnostic value in CED. Katalik et al. (1969) mentioned increased frequency of ulnar loops in CED in general and, especially, in ASD.

Unlike CED, only a few reports are available dealing with dermatoglyphics in rheumatic conditions. An exclusive study by Ashizawa and Assi (1973) on Japanese subjects, a brief note by Puri and Balakrishna (1971) are available apart from the most recent and thorough study by Annapurna et al. (1972). Ashizawa and Assi (1973) observed an increase in the frequency of arches in male rheumatic heart patients, whereas, Annapurna et al. (1972) noticed the contrary, i.e., a significantly lower frequency of arches in males. Both the studies observed a high frequency of whorls which was statistically significant. Puri and Balakrishna (1971) also obtained a high
incidence of whorls in the patients with rheumatic fever. Besides, they also reported a predominance of hypothenar patterns. Forthcoming evidence from later studies (Ashizawa and Assi 1973; Annapurna et al., 1978) contradicts this observation. A significant elevation in the frequency of patterns on IIIrd interdigital area was recorded by Puri and Balakrishna (1971) and Annapurna et al. (1978) which was not in agreement with Ashizawa and Assi’s study (1973). No significant difference was reported between Rheumatic heart patients and controls for patterns in the Th/I, II and IV interdigital areas (Ashizawa and Assi, 1973 and Annapurna et al., 1978), though Ashizawa and Assi (1971) reported a reduction in the frequency of interdigital patterns on IVth interdigital area in females with rheumatic heart disease.

There was only one study available on the patients with mitral valve prolapse by Swartz (1976). Arches showed a rough five fold increase in these patients when compared to the normal control. Arches on IVth and Vth fingers in patients were found to be more frequent than in control. This study might present an important supporting evidence ofmitral valve prolapse when evaluating patients with typical chest pain and palpitations.

There are a couple of studies (Fara and Sinha, 1969 and Kaplan et al., 1968) on Noonan’s syndrome which is usually associated with one or other congenital heart disease. But
Associated with OA (Nora and Sinha, 1968) which is usually associated with XO Turner's syndrome. In both the studies referred here, the congenital heart lesion being PR. Kaplan reported siren crease on the right palm and proximally placed until triradial. No siren crease was observed by Nora and Sinha in their 8 patients with Turner's phenotype and they have reported a low ridge count distinguishing this condition from XO Turner syndrome, which usually has a high ridge count.

Now for dermatoglyphics aid in clinical diagnosis, like differentiating a normal from a diseased person is a tricky question, but considering all the studies on CVD and its association with dermatoglyphics, its value in clinical diagnosis lies on its ability in differential diagnosis. For example if dermatoglyphics can help in separating cyanotic VCD from Fallot's Tetralogy or Fallot's Tetralogy from pulmonary stenosis, is to be worked out. A positive indications in this direction can put dermatoglyphics on the top of current scientific affairs.