

STUDY OF FLEXION CREASES AND RIDGES PATTERNS IN PATIENTS WITH CONGENITAL ANOMALIES OF APLASIA AND HYPOPLASIA OF THUMB.

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ABSTRACT

Present study was carried out on 120 hands, in which 60 hands were anomalous having aplasia and hypoplasia of thumb as cases and 60 hands were normal hands as control were studied. Aim of this study was to find out any ridges abnormalities in anomalous hands as ridges differentiation is closely associated with embryogenesis of limbs. Second aim is to find out any specific association between aplasia and hypoplasia of thumb and formation of thenar crease because of close association between presence of thenar volar pad and thenar crease during development of hand. We evaluated fingertip patterns, palmar pattern, position of axial triradius, and type of flexion creases either transverse type, transitional type, normal type (having distal, proximal transverse and thenar creases) and presence or absence of thenar crease.

Results of this study showed in aplasia of thumb there is increase in frequencies of unknown pattern, absence of axial triradius and absence of thenar crease. While in hypoplasia of thumb there is increase in frequencies of arches pattern, shifting of axial triradius distally, some cases showed absence of thenar crease and some cases having poorly formed thenar crease.

Conclusion of this study shows development of anomalous hand influences development of epidermis and so ridges pattern and formation of thenar crease associated with presence of thenar volar pad. In aplasia of thumb there is absence of thenar volar pad so there is no formation of thenar crease.

Key words: Aplasia of thumb, hypoplasia of thumb, thenar crease and volar pad.

INTRODUCTION

When we see the volar aspect of skin of the palm and finger, we find various linear markings, these linear markings are formed due to the underlying interlocking pattern of dermal papillae and overlying corresponding epidermal ridge. This arrangement is stable throughout the life, unique to the individual and therefore significant as a means of identification in forensic science. The ridge pattern and flexion creases can be affected by certain abnormalities of early in development, including genetic disorders. Cummins, H. and Midlow, C. (1926)¹.

The analysis of ridge pattern and flexion creases by studying prints of palm, fingers, sole of foot and toes is known as Dermatoglyphic. Cummins and Midlow (1961)² coined the term dermatoglyphic for study of ridges on the palm and sole. The term was universally accepted.

There are different theories for dermatoglyphics

features. Like Blanka (1961)³ he stated that this is due to polygenic system, multiple genes responsible for development of ridges and flexion creases and development of flexion creases in close relation with volar pad. Cummins, H. (1926)⁴ postulated that these features develop due to physical and topographical growth forces and development of flexion creases secondary to hand movement in intrauterine life. Patricia Collins (1995)⁵ stated somatopleuric mesenchyme controls the specific developmental fate of the overlying ectoderm that contribute the formation of ridges.

The characteristic configuration of dermatoglyphics has received attention in 17 century. The first report about the relationship between dermatoglyphics and disease was presented by Cummins, in 19 century in patients with Down's syndrome. He observed single transverse crease in such patients. Plato, C.C et al (1973)⁶ also analysis dermatoglyphics features in Down's to find out correlation between pattern and \$. Further study of flexion creases and ridges pattern has been done in various medical disorders and congenital malformation with aim to find out and estimation of their potential significance in medical practice.

In present study aim is to find out any ridges

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abnormalities in anomalous hands as ridges differentiation is closely associated with embryogenesis of limbs. Second aim is to find out specific association between development of thumb and formation of thenar crease because of close association between thenar volar pad and formation of thenar crease .

MATERIAL AND METHOD

The present study was carried out on 120 hands in which 60 anomalous hands having aplasia and hypoplasia of thumb served as cases and 60 normal hands not having any anomaly as control. These cases were obtained from Department of Physiotherapy of Sassoon General Hospital, Pune.

Criteria for selection of cases were patients having congenital anomalies of hands like , aplasia and hypoplasia of thumb .Type of anomalies shown in figure 1 (photographs 1 and 2) . whereas criteria for selection of control were, if patient one hand is anomalous normal hand of patient taken as control if both hands anomalous, normal hands of relatives taken as control.



Aplasia of thumb(1)



Figure (1): Hypoplasia of thumb (2)

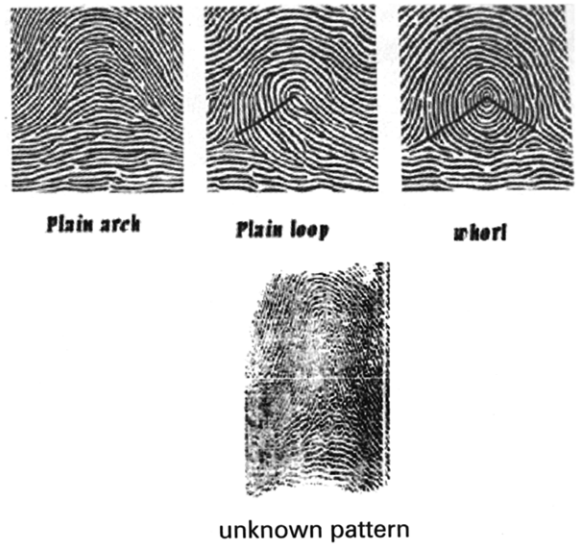


Figure-2-showing fingertip patterns.

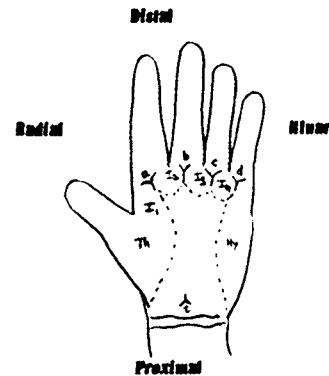


Figure-3-Palm showing dermatoglyphic pattern areas-
 a,b,c,d,t: palmar triradii
 I1,I2,I3,I4 : first to fourth interdigital areas
 Th: thenar area
 Hy : hypothenar area

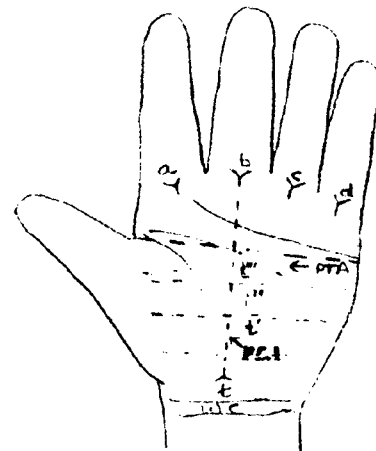


Figure (4): palm showing palmar triradii and anatomical position of axial triradius 't'.
 PTA:Palmar transverse axis
 PLA: Palmar longitudinal axis
 WL:Wrist crease

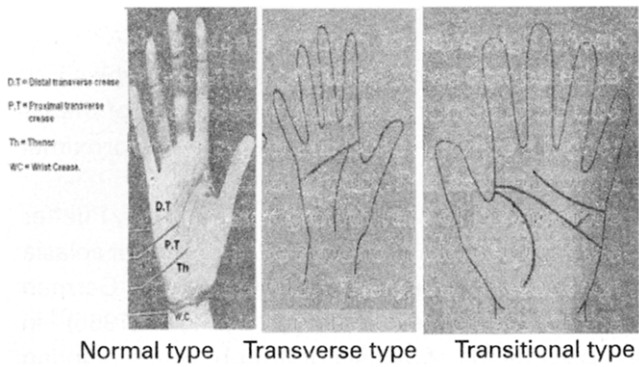


Figure (5)---Showing types of flexion creases.



Figure-6: Showing aplasia of thumb --absence of axial triradii and absence of thenar crease and ridges run transversely across proximal part of palm.



Figure-7-Normal hand showing thenar crease



Figure-8-Aplasia of little finger with fully developed thumb also showing Thenar crease.



Figure-9- Hypoplastic thumb showing rudimentary thenar crease

In aplasia of thumb there is absence of thumb, in hypoplasia of thumb, thumb will be rudimentary or reduced in length. Causes of these anomalies may be idiopathic, genetic, mutation of genes and environmental factors (Keith, L Moor et al 2003)⁷.

For taking print Ink method was used method described by Cummins and Midlow (1961)⁸. In which

black cylotyling ink was applied over the palm and fingers for taking print. After taking the prints, fingertip and palmar areas were studied for fingertip patterns, palmar patterns, anatomical position of axial triradius, and type of palmar flexion creases. For study of Finger tip pattern observe pattern on tip of the finger i.e loop, arch and whorl or unknown pattern described by Galton(1892)⁹. shown in fig(2).

For study of Palmar pattern palm has been divided into several anatomically defined areas shown in fig-3. These are Thenar, hypothenar and four interdigital areas. These areas are the approximate site of embryonic volar pads and observe three basic pattern (loop, whorl, arch) in the above mentioned area shown in (fig-3).

For study of anatomical position of axial triradius that 't' triradius (that is the meeting point of three opposing epidermal ridges). Palm is divided with help of PTA (palmar transverse axis) and PLA (palmar longitudinal axis).

Proximal part of the PLA then subdivided into four equal parts which denote the position of t as t', t'', t''' from proximal to distal point. In which t indicate proximal position while t', t'', t''' indicate distal position quoted by Bhanu, B.V. (1999)¹⁰. shown in (fig-4).

For study of palmar flexion creases observe types of flexion creases either normal type, transitional type and transverse type shown in fig-5.

In normal type all the three flexion creases presents i.e thenar crease, proximal transverse crease and distal transverse crease. In transverse type there is single transverse crease and thenar crease and in transitional type proximal transverse crease reached at level of ulnar border.

Data obtained from cases and controls were subjected to following statistical tests. Chi-square test is used for qualitative variables like finger tip pattern, position of axial triradius, palmar pattern and palmar flexion creases.

RESULTS AND OBSERVATION:

See table 1 and table 2

DISCUSSION

In the present study dermatoglyphics variations like the absence of digital triradii, distal displacement of an axial triradius and absence of thenar crease etc. commonly observed in patients with aplasia and hypoplasia of thumb. Such variations rarely observed in normal hands. So there may exist a correlation between dermatoglyphic abnormalities and the type

of anomaly.

Prominent findings in the present study in aplasia of thumb is absence of axial triradii, absence of thenar crease and ridges run transversely across proximal part of palm. Shown in Fig-(6)

such unusual arrangement reported by Pfeiffer and zuBerg(1964)¹¹ and Holt(1972)¹² in cases of aplasia of thumb due to thalidomide poisoning in German cases. Similar pattern observed by Adam(1965)¹³ in deformed hands of aplasia of thumb due to varying chromosomal aberration in chromosome no (13-15). Holt came to the conclusion that there is some connection between axial triradius, formation of thenar crease and thumb. He stated in a normal hand the ridges curve longitudinally over the thenar eminence and provide the three ridge systems necessary for the formation of a triradius. The curvature is associated with the presence of a pad. In thumbless hand there is absence of volar pad so there is no formation of axial triradii and thenar crease and ridges run transversely across the palm. So for formation of thenar crease must have thenar volar pad. This hypothesis supported by presence of thenar crease in normal hands and patients with aplasia of other fingers but having thumb. that is shown in fig-7&8.

Additional evidence in favour of this conclusion is provided by Mackenzie, H.J. and Penrose, L.S. (1951)¹⁴. They observed presence of axial triradius in case of ectrodactyly (lobster claw) due to dominant gene. According to them hands with thumbs, although grossly malformed, had axial triradius.

Prominent findings in hypoplasia of thumb are shifting of axial triradius distally, in some cases patients shows absence of thenar crease, in some cases thenar crease is rudimentary shown in fig-8. Thus hypoplastic thumb shows dermatoglyphic variations according to degree of hypoplasia of thumb. Holt (1972) observed same observation in hypoplastic thumb.

Popich, G.A and Smith(1970)¹⁵ observed relation between anomalous hand and formation of flexion creases and he draw the hypothesis formation of transverse crease influence by slopping alignment of 3rd and 4th metacarpal phalangeal joint nature of interdigital pad at the time of crease development. The results of present study along with those of other authors have shown certain specific association between congenital anomalous hands and dermatoglyphics patterns indicating that underlying

Parameters	Pattern	Normal hands	Anomalous hands	X ²	P-Value	S/NS P<0.05 –significant
Fingertip pattern	Loop	81	40	11.51	0.001	HS
	Arches	0	0	---	---	---
	Whorls	69	60	0.42	0.5	NS
	Unknown	0	20	27.00	0.00	HS
	Total	150	120(thumb Absent)			
Axial triradius	Proximal	28	0	52.50	0.00	HS
	Distal	2	0	2.06	0.15	NS
	Absent	0	30	60	0.00	HS
	Total	30	30			
Palmar pattern	l ₁	1	0	1.01	0.3	NS
	l ₂	0	0	---	---	---
	l ₃	1	0	1.01	0.3	NS
	l ₄	1	0	1.01	0.3	NS
	Hypothenar	0	0	---	---	---
Flexion creases	Normal	30	0	60.0	0.00	HS
	Transverse	0	0	---	---	---
	Transition	0	0	---	---	---
Thenar crease	Absent	0	30	60.0	0.00	HS
	Present	30	0	60.0	0.00	HS

Table: Aplasia of thumb (n30)

Qualitative dermatoglyphics pattern among normal hands and anomalous hands .

(n-number of anomalous hands, Ssignificant, NSnot significant,HS-highly significant)

Table I shows statistically significant increase in frequencies of unknown pattern,absence of axial triradii and absence of thenar crease and decrease in frequencies of loops patterns,proximal position of axial tridius,and normal flexion crease in the anomalous hands.

Parameters	Pattem	Normal hands	Anomalous hands	X ²	P-Value	S/NS P<0.05 – significant
Fingertip pattern	Loop	76	72	0.48	0.48	NS
	Arches	0	15	15.78	0.00	HS
	Whorls	74	57	3.91	0.048	S
	Unknown	0	6	6.12	0.013	S
	Total	150	150			
Axial triradius	Proximal	27	2	41.733	0.00	HS
	Distal	3	16	13.01	0.00	HS
	Absent	0	12	15	0.00	HS
	Total	30	30			
Palmar pattern	l ₁	1	0	1.01	0.3	NS
	l ₂	1	0	1.01	0.3	NS
	l ₃	0	1	1.01	0.3	NS
	l ₄	1	0	1.01	0.3	NS
	Hypothenar	1	1	---	---	---
Flexion creases	Normal	28	0	52.50	0.00	HS
	Transverse	1	0	1.01	0.3	NS
	Transition	1	0	1.01	0.3	NS
Thenar crease	Absent	0	12	15	0.00	HS
	Present	30	18 (rudimentary)	15	0.00	HS

Table II: Hypoplasia of thumb (n-- 30)

Qualitative dermatoglyphics pattern among normal hands and anomalous hands

(n-number of anomalous hands, Ssignificant, NSnot significant,HS-highly significant)

Table II shows significant increase in frequencies of arches pattern , shifting of axial triradius distally and some cases showed absence of thenar crease and some cases having poorly formed thenar crease while decrease in frequencies of proximal position of axial triradius and normal flexion crease in anomalous hands.

mesenchyme influences the development of epidermis derived from ectoderm and so the ridge pattern. Considering the findings in the present study their role can be put in the words of Watanabe, K et al(1994)16. From the position of axial triradius one can evaluate the functions of hands. If the position of axial triradius is proximal e.g. in polydactyly and normal hands there is good grasping function. If the position of axial triradius is distal like in aplasia of thumb, aplasia of fingers suggest poor grasping function.

This axial triradius is also helpful in estimating the time of damage of hand during embryogenesis, if there is absence of axial triradius it indicates that the time of damage was before the appearance of the pad for e.g. aplasia of thumb and that the degree of damage is severe. If axial triradius is placed distally it suggest degree of damage was not severe or the time of the damage was relatively late (until the completion of pad formation).

In present study there is significant dermatoglyphics variations observed in aplasia and hypoplasia of thumb like absence of axial triradius or its shifting distally and absence of thenar crease.

So from this results we can draw the conclusion that the underlying mesenchyme influences development ridges pattern and thenar crease formation associated with thenar volar pad whether the cause of anomalous hand is genetic or environmental during development of limb.

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