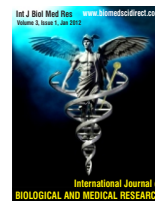




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Original Article

Study of Ridges Pattern in Patients with Congenital Anomalies of Hypoplasia of Fingers

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ABSTRACT

Abstract Present study was carried out on 20 hands ,in which 50 fingers of anomalous hand having distal phalanges hypoplasia as cases (10 hands) and 50 fingers of normal hands as control (10 hands) were studied. Aim of this study was to find out any specific association between distal phalanges hypoplasia of fingers and formation of ridges pattern .Here 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 distal phalanges hypoplasia of fingers there is increase in frequencies of arches pattern, shifting of axial triradius distally, and increase in frequency of transverse crease. Conclusion of this study shows there is close relationship between distal phalanges hypoplasia of fingers and high incidences of arches pattern. High incidences of arches in hypoplastic phalangeal skeleton associated with under development of the digital pad when the dermal ridges were developing during embryogenesis of hand.

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1. Introduction

Distal phalangeal Hypoplasia of fingers is one type of congenital anomalies of hand in which length of fingers/ toes reduce in height because of shortening of any bony components like metatarsal or phalanges. Common causes of the anomaly may be unknown in 50 to 60%, genetic factor, mutant genes or

environmental factors e.g. teratogens as thalidomide or combination of genetic and environmental factors.¹

When we see the embryogenesis of hand it is developed from limb bud, via a continual series of complex ectodermal and mesenchymal interactions in the lateral body wall (limb bud).where ectoderm gives rise to epidermis of skin while somatopleuric mesenchyme forms muscles, skeletal and other connective tissues. The apical ectodermal ridge exerts an inductive influence on limb mesenchyme, promoting growth and development of muscles and skeletal elements and somatopleuric mesenchyme controls the specific developmental fate of the overlying ectoderm.² As ridge differentiation is closely associated with embryogenesis of limbs, Mulvihill, J.J. and Smith, D.W. in 1969.³ They provided the most up to date version of how finger

print form. Between the sixth and tenth week in embryogenesis, pad appear on the fingers and palm and then disappear after participating in the formation of dermatoglyphics In 1924 Kristine Bonnevie⁴ postulated that the presence of volar pads as well as their size and position are to a large extent responsible for configuration of papillary ridge patterns, e.g. small pads would result in a simple pattern (arch), whereas more prominent pads would trend to lead to the development of large and more complex system of ridge configurations (whorls). So the aim of this study to find out fingertip pattern and palmer pattern in distal phalangeal hypoplasia that is associated with underdeveloped volar pad.

2. Material and Method

The present study was carried out on 20 hands in which 10 anomalous hands (50 fingers) having distal phalangeal hypoplasia of finger served as cases and 10 normal hands (50 fingers) 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 , distal phalangeal hypoplasia of fingers. Type of anomalies shown in figure 1 (photographs 1) where as 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.

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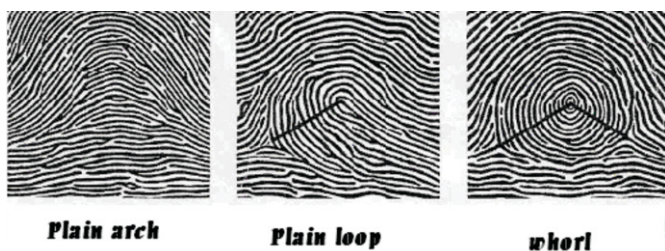
Photograph -1



Figure-1-showing distal hypoplasia of little finger

Study of fingertip pattern. Palmar pattern and flexion creases in hypoplastic fingers was done by taking prints of palm .

For taking print Ink method was used method described by Cummins and Midlow (1961)⁵. In which black cytotyling 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)⁶ shown in fig(2).



Figure—2—Showing fingertip pattern

a)Arch : It is simplest pattern on fingertips in which series of ridges enter the pattern area on one side of the finger and exist from opposite side. At the center of the pattern the ridges are slightly arched.

b)Loop : Series of ridges enter the pattern on one side of the finger and exit from same side.

c)Whorl : It is the most complex pattern in which ridges are arranged in series of concentric rings.

Pattern mostly seen in congenital anomalies of hands⁷ (Fig. 3):

Figure-3-showing unknown pattern



a)Ridge aplasia : absence of the ridges over entire volar aspect of hands.

b)Ridge hypoplasia : Epidermal ridges are reduced in height giving 'Worn off' appearance.

c)Ridge dissociation : Ridges are broken into short curved segments, in a chaotic disorganised way.

d)Ridges of the end : Instead of running transversely and flowing toward the opposite side of pattern, these ridges are vertical and run off the end of the fingertip.

For study of Palmar pattern palm has been divided into several anatomically defined areas shown in fig-4 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-4).

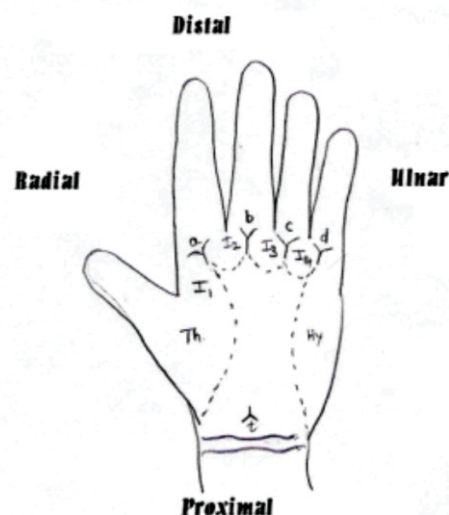


Figure-4-Palm showing Dermatoglyphic pattern areas-

a,b,c,d,t: palmar triradii

I1,I2,I3,I4 : First to Fourth interdigital areas

Th: Thenar area

Hy : hypothenar area

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'', t''' from proximal to distal point .t indicate proximal position while t', t'', t''' indicate distal position quoted by Bhanu,B.V.(1999)⁸.shown in(fig-5).

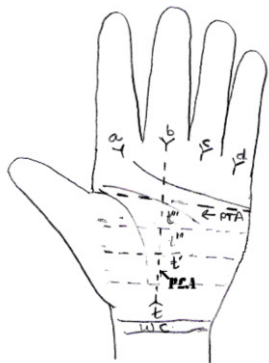


Figure (5): palm showing palmar triradii and anatomical position of axial

triradius 't'.

PTA:Palmar transverse axis

PLA: Palmar longitudinal axis

WL:Wrist crease

For study of palmar flexion creases observe types of flexion creases either normal type ,transitional type and transverse type shown in fig-6.

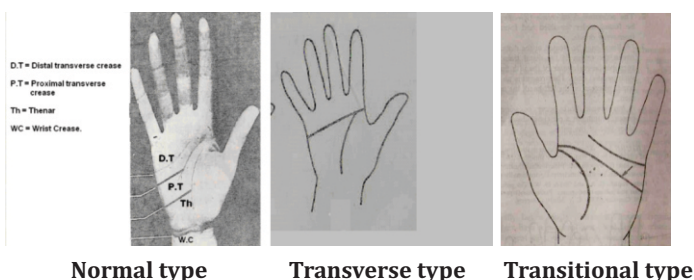


Figure (6)---Showing types of flexion creases.

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.

a-b ridge count—Triradii a and b are joined by straight line and number of ridges crossing or touching the lines are counted.

Digital triradii—There are four triradii in a normal hand at the base of four digits

Pattern intensity –Pattern intensity is the total number of triradii on the palm , including digital triradii,axial triradii, triradii on the interdigital and hypothenar areas.

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.

t-test: used for quantitative variables like a-b ridge count, digital triradii and pattern intensity.

Figure(7) - Dermatoglyphic pattern of distal phalangeal hypoplasia of little and ring finger



Figure-7 Distal Phalangeal Hypoplasia of fingers

Table 1 Qualitative Dermatoglyphics pattern among Normal hands (10) and Anomalous hands(10)

Parameters	Pattern	Normal hands	Anomalous hands	χ^2	P-Value
Fingertip Pattern	Loops	22	16	0.95	>0.05
	Arches	0	16	16	<0.001
	Whorls	28	3	20.16	<0.001
	Unknown	0	15	15	<0.001
	Total	50	50		
Axial triradii	Proximal	10	5	1.67	>0.05
	Distal	0	5	5	<0.05
	Absent	0	0	-	-
	Total	10	10		
Palmar pattern	I ₁	0	2	2	>0.05
	I ₂	0	0	-	-
	I ₃	1	0	1	>0.05
	I ₄	1	1	-	-
	Hypothenar	0	0	-	-
Flexion Creases	Normal	10	5	1.67	>0.05
	Transverse	0	5	5	<0.05
	Transition	0	0	-	-
	Absent	0	0	-	-

Table 1—normal hand Showing predominantly loop and whorl fingertip pattern, proximal position of axial triradii, and normal flexion crease whereas in distal phalangeal hypoplasia shows increase in frequencies of unknown pattern, arches, pattern axial triradius shifted distally and transverse crease and decrease in frequency of whorl pattern.

Table 5.2: Quantitative Dermatoglyphics features among Normal hands and Anomalous hands

Particular	Normal Hands Mean \pm SD	Anomalous Hands Mean \pm SD	t	P-Value
a-b ridge count	23 \pm 3.23	22.8 \pm 3.85	0.13	>0.05
Digital triradii	4 \pm 0	4 \pm 0	-	-
Pattern intensity	6 \pm 0.94	5.5 \pm 0.71	1.34	>0.05

Table 5.2 shows no significant difference in a-b ridge count, digital triradii and pattern intensity.

Discussion

In normal hands dermatoglyphics, pattern show, normal flexion creases there is no unknown fingertip pattern. These variations are commonly observed in patients with distal phalange hypoplasia of finger so there may exist a correlation between dermatoglyphic abnormalities and distal phalange hypoplasia. There are various hypothesis given by various author for ridges formation. Abel, W. in 1936,⁹ pointed imperfect ridge formation, due to

irregularities in tension and pressure within epidermal tissue during the period of ridge differentiation between 2nd and 4th fetal month. After that most thorough discussion of fingerprint formation comes from Mulvihill, J.J. and Smith, D.W. in 1969. They provided the most up to date version of how finger print form. Between the sixth and tenth week in embryogenesis, pad appear on the fingers and palm and then disappear after participating in the formation of dermatoglyphics. If no pad formation no pattern formation. In 1924⁸ Kristine Bonnevie postulated that the the shape of the digital and palmer pad determines the Dermatoglyphic pattern (arch, loop and whorls).

In 1972,¹⁰ Robinow, M. and Johnson, G.F. studied dermatoglyphics in distal phalangeal Hypoplasia. They found increased proportion of arches on finger tip. They offered a hypothesis that hypoplastic phalangeal skeleton was associated with underdevelopment of digital pad during embryogenesis when dermal ridges were developing.

Cummins (1923),¹¹ Mackenzie, H.J. and Penrose, L.S. (1951)¹² studied dermatoglyphic patterns of patients with malformed hand. They proved that epidermal ridges reflect the embryonic development of hand and feet so extent of dermatoglyphic alternations can be great, depending on the severity of hand or foot malformation like bizarre ridge arrangement and ridge directions and digital triradii and interdigital patterns may be so disturbed that cannot be identified.

Cooke, T.D.¹³ in 1955 observed dissociated and missing ridges on the fingertips of individual with severe hand malformation. In 1979,¹⁴ Suzuki, T. studied dermatoglyphics on the congenital hand anomalies of 94 cases with hand anomalies and 148 of their normal relatives as a control. An analysis of dermal ridge patterns was based on "the Memorandum of dermatoglyphic nomenclature" described by Penrose. They found hypoplastic fingers – high incidence of radial loops or arches (which is quite rare in normal fingers).

In the present study, in Distal Phalangeal Hypoplasia, observation table shows high number of arches pattern of fingertip. This finding is in accordance with Robinow, M. and Johnson, G.F. in 1972. and other authours.

From this study we draw the conclusion hypoplastic phalangeal skeleton was associated with underdevelopment of digital pad during embryogenesis when dermal ridges were developing, result into predomiently arches and unknown pattern.

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