
Development of human palmar and digital flexion creases

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To determine the timing of the development of the various palmar and digital creases, we examined the hands of 100 human fetuses obtained after therapeutic abortion. The fetuses ranged in age from 7 to 19 fetal weeks, with age being established by menstrual period dates and ultrasound examination before termination. Our observations show that palmar and digital creases develop between 8 and 13 fetal weeks. Digital creases are well defined by 10 weeks; palmar creases are consistently seen by 13 weeks of gestation. The volar pads are present from 8 to 14 fetal weeks. A hand malformation or specific insult that occurs before the time of crease development and that alters the form or function of the fetal hand can cause secondary alterations in crease patterns of the hand. (J PEDIATR 1988;113:428-32)

Hand creases have been studied for thousands of years by palmists or chiromancers, but only in the last 50 years has medical science attempted to study these creases in relation to medical disorders. Recently we were involved in the case of a baby who was exposed to carbon monoxide at 13 postmenstrual weeks of gestation. The baby had multiple congenital anomalies, including absent flexion creases of the fingers. This case led us to review the literature regarding flexion crease development in the human hand. We were surprised to find that the information was very limited and that conventional wisdom is largely based on a 1970 paper by Popich and Smith,¹ which states that hand creases develop between 7 and 14 weeks gestation. We performed the following study to determine the specific timing of the development of the various palmar and digital creases. Additionally, we considered the evidence regarding the origin of these creases.

METHODS

We examined 132 hands from 100 human fetuses obtained in unselected fashion after therapeutic abortion.

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None of the terminations were performed for suspected abnormalities. The fetuses ranged in age from 7 to 19 fetal weeks; at least 11 fetuses were examined at each week during the critical period of 8 to 12 weeks. Gestational ages were determined by a combination of menstrual period dates and ultrasound examination before termination. The hands were fixed in 10% formalin and examined under a dissecting microscope. Staining with toluidine blue did not significantly improve crease examination. All hands were evaluated by the same investigator (C.A.S.).

The nomenclature of palmar and digital creases is illustrated in Fig. 1. We developed a scoring system for evaluating the hands. If a crease or pad was absent, a negative was recorded. If it was barely visible, a 1+ was given, and if the crease was well defined, a 2+ was scored. The information was then compiled for hands at each week of gestation.

RESULTS

The Table summarizes the development of the palmar and digital creases and the volar pads. The figures in each column indicate the number of fetuses in which the specific crease or pad was at least faintly visible (1+ on the scoring system) on two or more fingers at that particular gestational age. There were some minor variations among fetuses of the same age, between two hands in the same fetus, and

between fingers on a single hand. However, the overall pattern and sequence of development were consistent. Fig. 2 illustrates fetal hands from 7 to 18 weeks of gestation. Formation of the various palmar and digital creases is outlined in the following paragraphs:

- 7 weeks** (Fig. 2, *a*), 6 hands, 4 fetuses: The fingers are separated, but the hand has a smooth, glovelike appearance without pads or creases. It is difficult to distinguish between the dorsal and volar surfaces of the hand, and the thumb is in the same plane as the fingers.
- 8 weeks** (Fig. 2, *b*), 21 hands, 17 fetuses: The first creases, primarily the distal interphalangeal and metacarpophalangeal creases, are faintly visible. The digital (fingertip) and interdigital pads are also seen. The thumb is starting to rotate into a different plane.
- 9 weeks** (Fig. 2, *c*), 32 hands, 23 fetuses: The distal interphalangeal and metacarpophalangeal creases are more distinct. Additionally, the proximal interphalangeal creases are faintly visible. The thenar crease originates at the radial side of the hand and extends proximally, encircling the thenar eminence. The thumb is now fully rotated, and the nail beds are beginning to form.
- 10 weeks** (Fig. 2, *d*), 14 hands, 11 fetuses: All digital creases are well defined by 10 weeks of gestation. The interdigital pads are beginning to regress, and a central depression is seen in each digital pad. Many small papillary integumentary thickenings are present in the center of the palm. The nail beds are better defined.
- 11 weeks** (Fig. 2, *e*), 19 hands, 13 fetuses: By 11 weeks the distal palmar crease is well defined. It extends from the area between the second and third metacarpophalangeal joints to the ulnar border of the palm. The proximal palmar crease is faintly seen, first visible at the radial edge of the palm and either fused with or just distal to the thenar crease.
- 12 weeks** (Fig. 2, *f*), 17 hands, 12 fetuses: The proximal palmar crease is consistently seen extending from the radial edge of the palm to the medial border of the hypothenar eminence. The digital pads are well seen, but the interdigital pads are now gone.
- 13 weeks** (Fig. 2, *g*), 7 hands, 5 fetuses: By 13 weeks of gestation, all palmar and digital creases are well defined. The digital pads are beginning to regress.
- 14 to 16 weeks** (Fig. 2, *h*), 8 hands, 7 fetuses: There is little change in appearance of the fetal hand during this time. The digital pads are absent by 15 weeks.
- 17 to 19 weeks** (Fig. 2, *i*), 8 hands, 8 fetuses: The proximal interphalangeal creases appear double. This extra crease, which appears distal to the proximal interphalangeal crease, is limited to the volar side of the digit, whereas the distal interphalangeal, proximal interphalangeal, and metacarpophalangeal creases all extend onto the lateral aspect of the digit.

DISCUSSION

There has been some disagreement regarding the origin of palmar and digital creases. In 1937, the German researcher Würth² found that hand creases develop during the second and third embryonic months of life. He con-

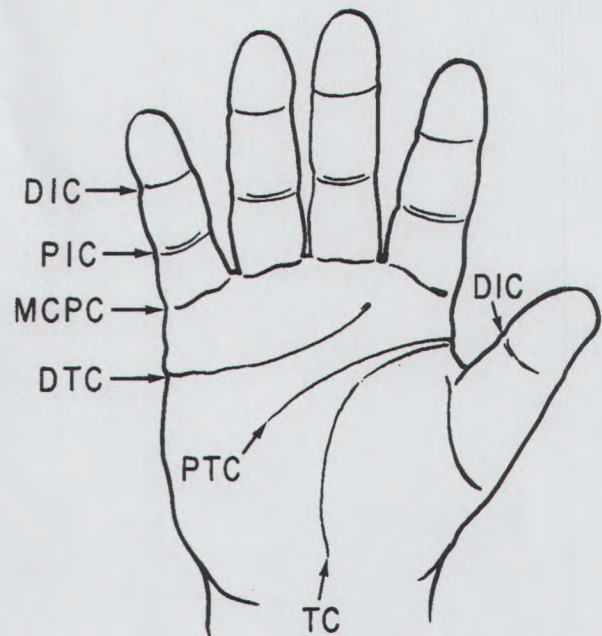


Fig. 1. Hand crease nomenclature. *DIC*, Distal interphalangeal crease; *PIC*, proximal interphalangeal crease; *MCPC*, metacarpophalangeal crease; *DTC*, distal transverse crease; *PTC*, proximal transverse crease; *TC*, thenar crease.

cluded that the flexion creases develop independently of palmar and finger movement because he thought that the hand musculature was not sufficiently developed for flexion to occur. Kimura and Kitagawa³ also proposed that hand creases develop independently of flexion movements. Those investigators based this conclusion largely on studies by Humphrey,⁴ which show that spontaneous hand movements are not observed in the fetus of less than 11.5 weeks gestation. However, Humphrey actually stated that palmar sensitivity and finger flexion are observed by 10.5 weeks of menstrual age, which corresponds to 8.5 fetal weeks and is consistent with our observation of the earliest appearance of flexion creases on the fingers.

The second hypothesis is that hand creases are secondary features determined by the form and function of the developing hand. This view is supported by studies of creases in malformed hands performed by Popich and Smith.¹ Additional evidence includes the correspondence of the creases to the location of the underlying joints of the hand. Two crease variations have been observed that cannot be explained by this second hypothesis. An extra interphalangeal transverse crease between the metacarpophalangeal and proximal interphalangeal creases of the fifth finger was observed in 4 of 551 people by Komatz et al.⁵ In none of the cases was this extra crease associated with an underlying bone or joint abnormality. The second observation is that of an extra transverse crease just distal