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Inhaber: Marina Kisiliuk

Tel.: + 49 51519191533

Fax.: + 49 5151 919 2560

Email: info@dwherold.de

Internet: www.dwherold.de

Chefredakteur/Editor-in-chief:

Marina Kisiliuk

Korrektur:

O. Champela

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Edmundas.Kadusevicius@lsmuni.lt

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i.grabchev@chem.uni-sofia.bg
grabchev@mail.bg

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ryana_1@yahoo.com

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tmarinova@yahoo.com

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mitovplamen@gmail.com

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anivel@abv.bg

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Indijharnaray@gmail.com

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payfer@cu.edu.tr

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tusharkantighosh53@yahoo.in

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khuda1949@mail.ru

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satleonid@gmail.com

Lists of references are given according to the Vancouver style

Teplytskyi S.S.

Department of general surgery of the Baruch Padeh, Poria Medical Centre, Lower Galilee, Israel

FORMATION AND DEVELOPMENT OF THE SKIN ON THE PALMAR SURFACE OF THE HAND THROUGHOUT THE PERIOD OF PRENATAL ONTOGENESIS AND ITS IMPORTANCE IN DERMATOGLYPHICS

Abstract. *The review article deals with a topical issue of hand skin morphogenesis in the early period of human ontogenesis, it highlights the stages of formation and development of the palmar skin of the hand and its significance in dermatoglyphics.*

Key words: *morphogenesis, prenatal ontogenesis, skin, palmar surface of the hand, dermatoglyphics.*

According to E. I. Danilova (1979), man does not have an organ like the hand that would possess such a wide range of functional capabilities at once and would perfectly combine such a significant force, great tactile sensitivity, virtuosic dexterity and ability to the finest manipulations that are performed by the fingers [4].

Despite a huge number of morphological studies, even today the question arises: what is the morphological basis of the highly developed multifunctional human hand and what are its morphofunctional elements? Answers to these questions can be given by morphological and comparative anatomical studies of the development of the hand throughout the entire prenatal ontogenesis, from the anlage to the birth of the child.

Looking through the foreign and domestic literature [2, 4, 7, 9, 11, 13-15, 19, 20, 23] testifies that, despite a relatively large number of works devoted to the study of the morphogenesis of the human hand, only some works are based on the study of its morphology in different age periods of prenatal ontogenesis.

Most reports indicate that the anlage of the upper limb in humans appears in embryos of 4.0-5.0 mm of the crown-rump length (CRL) in the form of crests of the trunk on the site, that is, 6 somites [14, 16]. In this stage of the anlage the hand that looks like a bud, is represented by a non-differentiated layer of the mesenchyme covered by epithelium, which forms the outer layer of the skin, or the epidermis. At the 6th week (embryos 13.5-14.0 mm CRL) of the embryonic development, the anlage of the hand resembles a

shovel or an oar and connects to the trunk with a wide isthmus. The pre-fetuses aged 7 (17.0-20.0 mm of the CRL), have the rudiments of the fingers in the form of five protuberances, which are connected by bridges. At the end of the 8th week the pre-fetuses' (25.0-27.0 mm of CRL) fingers are lengthened and separated, their differentiation is completed. The crest skin of the human body is formed in the fetal period in the 3rd to 6th months of intrauterine development (K.A. Kalantaevskaya, 1972, I.S. Guseva, 1986). A two-month fetus has blood vessels of the skin deep network. In the beginning, according to a number of authors [1, 3, 11, 14, 16, 24], all epithelial coverings of the skin of the upper limb rudiment, as well as other areas of the embryo body, are represented by a single layer of cubic cells with clearly placed nuclei. At the end of the 4th week (5.0-6.0 mm CRL) it becomes prismatic [2], and in embryos with 7.0-9.0 mm CRL it consists of two layers due to the fact that some prismatic epithelial cells begin to protrude towards the surface forming a thin layer of flat cells - periderm, which performs a protective function, keeping the skin from maceration with an amniotic fluid [10,16]. According to Yu.N. Shapovalov (1983), in the embryos of the 6th week (9.0-11.0 mm of TCD), the epithelium is thickened at the apex of the rudiment of the upper extremity and is represented by 4 layers of cells [2, 3].

By the end of the 8th week (21.0-30.0 mm of CRL), the skin epithelium begins to thicken due to the displacement of nuclei and the redistribution of the cells of the Malpighian layer. Thus, there is a third - an intermediate layer, which is located between the flat cells of the periderm and the

basal layer, which borders on the skin. The cells of the intermediate layer begin to elongate and become markedly vacuolated.

During the 9-12th weeks (31.1-80.0 mm CRL), the basal layer of cells begins to differ sharply from the remaining layers of the epithelium. These cells, continuously multiplying, form a germinative layer, which ensures the growth of the entire epidermis.

During the 13-16th weeks (81.0-200.0 mm CRL), the epithelium becomes multilayered and approaches its definitive structure.

At the 17-19th weeks of embryonic development the process of keratinization begins, which is accompanied by the formation of a typical granular layer. The fetus with 240.0 mm CRL has epidermis of the skin of the fingers with clearly expressed keratinization.

At the end of the 28th week the epithelium of the hand skin, contains already all layers of cells that are characteristic for fully developed skin:

- the stratum corneum proper formed by horny scales;
- the shiny layer with the inclusion of elendin;
- the granular layer, in the cells of which one can see the grains of keratogialin;
- A layer of spiky cells with pronounced intercellular bridges;
- the basal layer, which manifests itself by basophilia of the cellular cytoplasm [8, 11, 13, 14].

The skin, or corium, which is developing, consists of a densely woven layer of fibrous connective tissue that is located directly under the epidermis. It is formed from the mesenchyme of the cells that migrate from dermatomes located under the ectoderm (partly from the parietal sheet of the splanchnotome) [14-16]. In its differentiation, the main dependence on the differentiation of the epithelium, which covers it, is expected. During the 20-23rd weeks, the amount of collagen fibers of the skin increases significantly, especially in the palms of the hands, where they begin to be placed in bundles. In fetuses of 200.0 mm of CRL there no bundles in the fluffy connective tissue, which closes the terminal sections of sweat glands.

In the early stages of skin development (4-9th weeks), the junction of the epithelium and connective tissue remains smooth. However, during the 13-16th weeks, when the epithelium

thickens, its internal surface becomes uneven, forming ridges and cavities, which are filled with the connective tissue. By the 19-20th weeks these structures are transformed into very complex designs, which are well traced on fingerprints and form a unique and individual pattern for each person. In addition to these furrows, the skin on the palms contains local elevations of the corium (dermis) corresponding to small depressions on the inner surface of the epithelium. Such connective tissue protrusions are called dermal papillae [18].

Having analyzed a large number of scientific works, I.S. Guseva (1986), identified three main stages in the formation of crested human skin:

1. The preparatory stage, which is characterized by the formation of predisposition to crest formation and preparation for the "launch" of genes. This stage lasts from the end of the 8th to the beginning of the 10th week of embryogenesis.

2. The stage of crest formation and formation of types of papillary patterns. At the 10-11th week of embryonic development, the genes responsible for the formation of crested skin (its specific details and surface relief) join in the work. The stage lasts until 22-24th weeks of intrauterine development of the fetus. By this time the relief of the skin reaches its final maturity.

3. The stage of maturing the crested skin: begins with the 24th week of development of the fetus and finishes with the birth. At this stage the crested skin matures as a tactile organ, a strong protective horny layer is formed. Consequently, by the birth of a child, its crested skin is formed to tactile perceptions.

Thus, the morphogenesis of the skin of the hand and its palmar surface in the early period of ontogeny of the human body has its own peculiarities. For instance, the anlage of the upper limb in a man begins on the 4-5th weeks of the prenatal period, and the formation of the skin of the hand and its palmar surface begins at the 6th week from the non-differentiated mesenchyme covered with epithelium, which consists of one layer of cubic cells. In the same period of the development of the embryo, when the hand resembles a wide jagged blade, there are volar elevations in the regions of II, III and IV interphalangeal spaces. Volar elevations are the

zones on which the papillary pattern will be formed. The third through sixth months of embryonic development are a period of intense cristae formation, in particular maturation of the epidermis and dermis. In the dermis, the papillary and reticular layers are formed. Dermal papillae form against the background of intensive growth of the papillae of the epidermis - the rudiments of the ducts of the sweat glands. By the 15-17th weeks, the formation of the crests is spread over the entire finger-cushion. On the distal phalanges of the fingers of the fetus of this age, the types of patterns can be already differentiated. The pattern begins to form from the central fragment and lateral rank, and only in the final stages delta appears. Later, the crested skin is formed as a tactile organ. Papillary patterns remain unchanged (I.S. Guseva, 1980).

In the 27-28th weeks of the fetal period, the skin epithelium already has all the layers of cells that are typical for fully developed skin. In addition, one can not underestimate the unrivaled importance of the skin structure of the palmar surface of the hand in criminalistics. The scientific basis for identifying a person by their hands is directly related to the anatomical features of the structure of the human skin. Individuality determines the uniqueness of the particular person's hand traces. Even in identical twins, the totality of details in the structure of skin patterns is never repeated. Over the last hundred years, no cases of coincidence of cutaneous patterns in different people have been revealed in world practice [5, 6, 17, 18, 21, 24, 25]. Moreover, the small features of papillary patterns create combinations - a macrostructure that is unique even on the fingers of the same person. Therefore, in identification, criminologists actively use not only the macrostructure of the papillary pattern, but the microstructure as well, expressed in the features of the structure of the papillary lines (edgescopy) and pores (poroscopy).

Another property of the skin of the fingers and palms of the hands is the ability to imprint on those objects to which the human hands touched. And the formation of prints occurs regardless of the will of a person, which is due to the physiological properties of the skin – the fact that the surface of the skin is always covered with secretions of sweat and fat. Moving when touched

on an object, they form imprints on it, copying papillary patterns.

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