

f) 06 Chapter 3 Review of Literature Kesha (Hair anatomy and physiology)

निरस्ति :- किलश+अन् =केश

केश word is used in Ayurveda for hair.

किलश+अन् =केश

This Dhatu is used as किलश्यते किलश्राति वा। [1]

केश स्थान = Klish, Un- The hair of the head [2]

शिरोरुङ्खः = केश:

According to Aacharya Chakarpaani Shiroruha word is used for as a synonym of hair [3] and the word Shiroruha means hair of the head as per dictionary [4]

Nature of Kesha in Ayurveda

Hair is factor derived from Pitrij Bhava (Paternal) in foetal body. As propounded by lord Dhanvantari describing parts of the foetal body originating that head hair, beards, moustaches and hard parts are the parts which originate from father. [5]

The foetus is produced from out of the father (from sperm). [6] Without father there is no possibility of conception and birth of viviparous creatures. There are some organs those organs which are derived from paternal source, (from sperm) and which are formed because of existence of the father.

They are hair of the head, hair of the face, nail, and small hairs of the body, teeth, bones, veins, ligaments, arteries and semen (These are the organs derived from paternal source).

A special growing nature of hair present in human being that the two- nails and hair- constantly grow by nature in spite of the wasting of body. [7]
Drastic effect of combing on hairs found that combing is good for hair and removes dust, louse and dirt. [8]

In case of use of poisoned comb there are falling of hair, headache, bleeding from passages and appearance of cysts on head. [9]

The dressing and cutting of hair, beard and nails adds the corpulence, libido, longevity, cleanliness and beauty. [10]

The mind and body together with the sense organs exclusive of ‘Kesha’, small hair, tip of the nail, ingested food, excretory fluids and objects of senses are the sites of manifestation of happiness and miseries. The fact that hair etc. is excluded from the purview of consciousness can be ascertained from direct experience. [11]

After performing the rites for giving a name to the child he should be examined with a view to ascertaining the span of his life. Discrete, soft, sparse, unctuous, firmly rooted and black hair is signs and symptoms of children having a long span of life. [12]

**Mahabhautic predominance in ‘kesha’ (hair)**

Body organs are dominated by one or other of the ‘Mahabhutas’. Organs which are gross, stable, having form, heavy, rough, and hard like nail, bone, teeth, flesh; skin, feces and hair are dominated by ‘Prithvi’ [13]

‘Kesha’ is as ‘Mala’ (waste product)

‘Kesha’ (big hair), and ‘Loman’ (small hair) are ‘Mala’ (waste product) of ‘Asthi Dhatu’ a tissue element. [14]

‘Prakriti’ and hairs [15]

**Vata:-**
Hence persons born with the predominance of ‘Vata Prakriti’ generally have hair and body which are cracked and dusky (Lustreless).

**Pitta:-**

Persons having predominance of ‘Pitta’ have very keen thirst, hunger and have brown and scanty hair. They possess grey hair, wrinkles, and blue patches on the skin.

**Kapha:-**

Persons of ‘Kapha Prakriti’ are mild in nature, big elevated chest, and big forehead, thick and blue hair, soft, even, well defined and good looking body.

Hair has little remaining physiologic importance, but great psychological significance.

**Hair follicle:-**

![Figure No. 1](image-url)
A hair follicle is a mammalian skin organ which yields hair. Hair production occurs in three phases, including growth (anagen), cessation (catagen), and rest (telogen) phases. Stem cells are responsible for hair production.

**Structure:-**

The papilla is a bulky structure at the base of the hair follicle. The papilla is made up mainly of connective tissue and a capillary loop. Cell division in the papilla is either rare or non-existent.

**Matrix:-**

Around the papilla is the hair matrix. It is a collection of epithelial cells frequently combined with the pigment-producing cells called Melanocytes. Cell division in the hair matrix produces the cells that form the major structures of the hair fiber and the inner root sheath. The hair matrix epithelium is one of the fastest growing cell
populations in the human being, which is why some forms of chemotherapy or radiotherapy, which exterminate dividing cells and may conduct to temporary hair loss. The papilla is usually pear or ovoid shaped. The matrix wraps completely around it, except for a short stalk-like connection to the surrounding connective tissue. This provides access for the capillary.

**Root Seath:-**

The root sheath is composed of an external and internal root sheath. The external root sheath emerges empty with cuboid cells when stained with H&E stain. The internal root sheath is composed of three layers, Henley’s layer, Huxley’s layer, and an internal cuticle layer which is continuous with the outermost layer of the hair fiber.

**Bulge:-**

The bulge is located in the outer root sheath at the insertion position of the arrector pili muscle. It houses several types of stem cells, which supply the entire hair follicle with new cells, and take part in healing the epidermis after a wound.\[^{16}\]

**Other Structures:-**

Other structures associated with the hair follicle contain the cup in which the follicle grows known as the infundibulum, the arrector pili muscles, the sebaceous glands, and the apocrine sweat glands. Hair follicle receptors sense the position of the hair.
Hair follicle and other structures

Attached to the follicle is a tiny bundle of muscle fiber called the *arrector pili*. This muscle is liable for causing the follicle lasses to become more perpendicular to the surface of the skin, and causing the follicle to project slightly above the surrounding skin (piloerection) and a pore encased with skin oil. This process results in goose bumps (or goose flesh).

Also attached to the follicle is a sebaceous gland, which produces the oily or waxy substance sebum. The higher density of the hair, the more sebaceous glands there are found.
Hairless and hairy skin is found as below.

**Figure No. 4**

The establishment of a dermal papilla (DP) is vital to the development of all hair follicles. DP is a group of specialized dermal fibroblast cells. They are derived from the embryonic mesoderm. They aggregate in the dermis just below the epidermis.

The very first stages of hair follicle embryogenesis are shown in the figures below.

At stage 0; in figure No. 5 before hair follicle development, the epidermis and dermis are uniform. At stage 1, in figure No. 6 a few dermal fibroblast-like cells aggregate below the epidermis and the epidermal cells above the aggregation become larger. At stage 2 in figure No. 7 the epidermal cells start proliferating and push down into the dermis following the dermal papilla cells.
Stages of hair follicle embryogenesis

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<th>Stage 2</th>
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<td>Figure No. 7</td>
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The dermal condensate signals the follicular epithelium (peg) to proliferate and grow down into the dermis. The dermal condensate becomes enveloped by the follicular epithelial cells and the Dermal Papilla is formed.

At least 7 different epithelial layers constituting the components of the mature hair follicle are formed.

At this time, 3 bulges appear on the follicle wall.

A. Upper forms APOCRINE glands in appropriate locations
B. Middle forms SEBACEOUS glands

C. Lower forms the important HAIR BULGE and is the site of arrector pili muscle attachment. Melanocytes become interspersed among the keratinocytes.

As the epidermal plug penetrates down into the dermis, mesodermal cells congregate around it. The mesodermal cells develop into a fibrous follicular sheath or collagen capsule to encase the epidermal cells.

**Dermal Papilla**

**Cross Sectional Anatomy (center to periphery)**

![Cross Sectional Anatomy](image)

*Figure No. 8*

1. **Medulla:-**

   Found only in large terminal hairs, generated from matrix cells at tip of dermal papilla.

2. **Cortex:-**

   Thick layer of elongated keratinocytes formed from matrix cells. It makes up the bulk of the hair shaft and contains melanin granules.

3. **Hair Cuticle:-**
Single outer layer of imbricated keratinoytes (like roof tiles).

4. **Inner Root Sheath (IRS):**

   It is made up of 3 layers; does not contain melanin and formed from matrix cells (at periphery of follicle) in pace with the hair shaft.

   It dictates the shape of the hair since it hardens (keratinizes) first. IRS cells are shed into the infundibulum as the hair shaft grows. The products of the sebaceous glands help to break down the IRS.

5. **Outer Root Sheath (ORS):**

   It is reservoir for melanocytes, epidermal cells that repopulate the epidermis after injury.

6. **Glassy or Vitreous Membrane:**

   A-cellular basement membrane bounding the entire follicle becomes grooved in catagen, therefore, can be used as marker of this phase.

7. **Fibrous Root Sheath:**

   This is the outermost layer continuous with the dermis.

**Hair Growth Cycle:**

Hair grows in cycles of various phases. \(^{[17]}\) anagen is the growth phase; catagen is the involuting or regressing phase; and telogen, the resting or quiescent phase. Each phase has several morphologically and histologically distinguishable sub-phases.

**Follicular morphogenesis:** - Prior to the start of cycling is a phase of follicular morphogenesis (formation of the follicle). There is also a shedding phase, or exogen, that is independent of anagen and telogen in which one of several hair that might arise from a single follicle exits. Normally up to 90% of the hair follicles are in anagen phase while, 10–14% are in telogen and 1–2% in catagen. The cycle's length varies on
different parts of the body. For eyebrows, the cycle is completed in around 4 months, while it takes the scalp 3–4 years to finish; this is the reason eyebrow hair have a much shorter length limit compared to hair on the head. Growth cycles are controlled by a chemical signal like epidermal growth factor. DLX3 is a crucial regulator of hair follicle differentiation and cycling. All animals (except Merino sheep & poodles) have hair those cycles between active (anagen), regression phase (catagen) & resting (telogen) states. Hair length is dependent on length of Anagen. Scalp hair has the longest anagen phase (3-7 years), eyebrows have the shortest anagen phase.

Follicular Morphogenesis

![Follicular Morphogenesis](image)

**Figure No. 9**

**Hair Growth Cycle Anagen**

1. It is the growth phase.
2. The root of the hair is embedded deep in the dermis/subcutis.
3. Large and has pigment
4. Lasts for 2-7 years

80-90% of scalp hair is in growing phase. Unclear what physiologic events stimulate growth assumed that factors from the dermal papilla regulate anagen onset.
Anagen is the active growth phase of hair follicles\textsuperscript{[18]} during which the root of the hair is dividing rapidly, adding to the hair shaft. During this phase the hair grows about 1 cm every 28 days. Scalp hair stays in this active phase of growth for 2–7 years and is genetically determined. At the end of the anagen phase an unknown signal causes the follicle to go into the catagen phase.

**Hair Growth Cycle Catagen**

1. Regression phase
2. Hair does not grow
3. Moves closer towards the epidermis
4. Takes the form of a club hair
5. Lasts about 2-3 weeks

The catagen phase is a short transition stage that occurs at the end of the anagen phase.\textsuperscript{[19]}

It signals the end of the active growth of a hair. This phase lasts for about 2–3 weeks while the hair converts to a club hair. A club hair is formed during the catagen phase when the part of the hair follicle in contact with the lower portion of the hair becomes attached to the hair shaft. This process cuts the hair off from its blood supply and from the cells that produce new hair. When a club hair is completely formed, about a 2-week process, the hair follicle enters the telogen phase.

Only 1% of follicles in this stage lives. Mitosis ceases in the matrix and the cells keratinize forming a club hair than apoptosis occurs now melanocytes stop producing pigment. Melanocytes withdraw their dendrites so the club end of the hair is not pigmented.

**Hair Growth Cycle Telogen**

1. Resting phase
2. Hair can now be considered dead
3. It will fall out
4. Gets smaller and lighter
5. Moves towards the epidermis
6. Pushed out by new hair growing in
7. Lasts 3 months

The telogen phase is the resting phase of the hair follicle. When the body is subjected to extreme stress, as much as 70 percent of hair can prematurely enter a phase of rest, called the telogen phase. This hair begins to fall, causing a noticeable loss of hair. This condition is called telogen effluvium. The club hair is the final product of a hair follicle in the telogen stage, and is a dead, fully keratinized hair. Fifty to one-hundred club hairs are shed daily from a normal scalp.

The period of complete telogen is (inactivity) lasts about 100 days (3 months) in the scalp. 5-10% of follicles scalp loses 100-150 telogen hairs a day, which is only a small percentage of the total of hairs in this phase. Club Hair either falls out during telogen or is pushed out by new hair growth during the next anagen phase.

**Control of Hair Growth Hormones Androgens:**

The most important hormonal regulators act through receptors in the dermal papilla. They raise the length of anagen, diameter, and growth rate in susceptible follicles. Paradoxically cause shorter anagen time, miniaturization, and slower growth in areas such as the scalp. Axillary & Pubic hair respond to testosterone, rest of body hair only responds to DHT made by 5-alpha reductase. Estrogen prolongs anagen phase but decreases the growth rate and responsible for the post-partum telogen effluvium. Thyroxin advances onset of anagen increases growth rate. Excesses can be stressful and lead to telogen effluvium. Deficiency can do the same in addition to slowing growth rate.
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तवाधिकन्तमाधिकमोहंकर्णरादि तत् पार्थिवं गन्धो प्राण
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