Hair is a filamentous (threadlike) biomaterial, that grows from follicles found in the dermis. It is composed of protein, notably keratin. Hair is one of the defining characteristics of mammals. The human body (apart from areas of glabrous skin: palm, sole and lips), is covered in follicles which produce thick terminal and fine vellus hair.

2 Textures of the hair: 1- Curly hair 2- Straight hair

<table>
<thead>
<tr>
<th>1- Lanugo hair</th>
<th>2- Vellus hair (intermdiate)</th>
<th>3- Terminal hair: (Androgenic hairs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In utero, shed during the end of pregnancy &amp; the 1st months postpartum</td>
<td>on children &amp; adult women</td>
<td>on men &amp; develop (during &amp; after puberty)</td>
</tr>
<tr>
<td>Long, unmedullated</td>
<td>Short, (less than 2 mm long), fine, light-colored (nonpigmented)</td>
<td>Long, medullated, thick, and dark</td>
</tr>
<tr>
<td>H Fs Penetrate only into the papillary dermis</td>
<td>H Fs Penetrate only into the reticular dermis</td>
<td></td>
</tr>
<tr>
<td>is not connected to a sebaceous gland</td>
<td>is connected to a sebaceous gland</td>
<td></td>
</tr>
<tr>
<td>Replaced by vellus hair (at 36 to 40 wks of gestation)</td>
<td>on most of a person’s body from his / her childhood</td>
<td>* On (face, beard, area chest, abdomen, leg and arm &amp; foot) * Vellus replaced by terminal During puberty due to ↑ in testosterone</td>
</tr>
<tr>
<td>In inherited baldness terminal is replaced by vellus</td>
<td>As a secondary sex characteristic Pubic and Axillary hair will develop on both men and women</td>
<td></td>
</tr>
</tbody>
</table>

2 Types of skin:
1- Glabrous thick (hairless) skin, Thick Strat. corneum: e.g. : Palms & Soles
2- Thin (hairy) skin: the rest of the body

Function of the hair: Hair provides
1. Thermal regulation and
2. Camouflage

3 Types of hair: 1- Lanugo hair 2- Vellus hair 3- Terminal hairs: (Androgenic hairs)

Hair has 2 distinct structures: Hair Follicle & Hair Shaft
1. The Hair Follicle

(or when pulled from the skin, called the hair bulb: hair bulb contains the cells that produce the hair shaft). Hair follicle: is located in the dermis, maintains stem cells which regrow the:

a. hair after it falls out
b. skin after a wound

It contains melanocytes. Stem cells are principally responsible for the production of hair.

Structure of hair follicle

1- The papilla
    * is a large structure at the base of the hair follicle
    * is made up mainl of CT and a capillary loop

2- Matrix: is around the papilla

3- The external and internal root sheath

4- The hair fiber is composed of keratin.

5- Structures associated with the hair follicle are:
    A- Apocrine sweat gland
    B- Sebaceous gland: lubricates the hair
    C- Arrector pili muscles, which are responsible for causing hairs to stand up

2. The Shaft

It is the hard filamentous part that extends above the skin surface. A cross section of the hair shaft (Strand of hair or Hair fibers) is divided roughly into 3 zones, starting from the outside: A. The cuticle  B. The cortex  C. The medulla:

The diameter of human hair is (17 - 180 micrometers) Hair growth begins inside the hair follicle.

Women predominantly grow the hair on their head long while men cut theirs short. No. of scalp hair follicles is 100,000.

All natural hair colors are the result of 2 types of hair pigment. Both of these pigments are melanin types, produced inside the hair follicle and packed into granules found in the fibers.
1- **Eumelanin**: is the dominant pigment in: dark-blonde, brown hair, and black hair

2- **Pheomelanin**: (pheo: gray)
   - Gray hair occurs when melanin production decreases or stops.
   - is dominant in red hair.
   - Blonde hair is the result of having little pigmentation in the hair strand.

**Hair-follicle cycling (Human hair growth)**

Hair grows everywhere on the external body except on
- mucous membranes (lips) and
- glabrous skin (the back of the ear, the palm of the hand, the sole of the foot, some external genital areas, the navel ‘umbilicus’ and Scar tissue)

The hair grows about 1 cm every 28 days. Shaving has no effect on the hair cycle. 3 hair cycles: All occur simultaneously; one strand of hair may be in the anagen phase, while another is in the telogen phase:

1- **Anagen phase**
2- **Catagen phase**
3- **Telogen phase**

<table>
<thead>
<tr>
<th>1- Anagen phase</th>
<th>2- Catagen phase:</th>
<th>3- Telogen phase:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active growth phase</td>
<td>Cessation, Involuting or Regressive phase</td>
<td>Resting or quiescent phase</td>
</tr>
<tr>
<td>2–3 years which is genetically determined</td>
<td>2–3 weeks</td>
<td>2-3 months</td>
</tr>
<tr>
<td>At the end it passes into the catagen phase.</td>
<td>Converts to a club hair and enters the telogen phase</td>
<td>The club hair is the final product of a hair follicle and is a dead, fully keratinized hair.</td>
</tr>
<tr>
<td>85-95%</td>
<td>1%</td>
<td>10–15%</td>
</tr>
<tr>
<td>Its length determines the length of the hair</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q: Why the eyebrow hairs have a much shorter length compared to hairs on the head.

A: Because the cycle's length varies on different parts of the body; for eyebrows, the cycle is completed in 4 ms; it takes the scalp 2-3 years to finish

<table>
<thead>
<tr>
<th>Phases:</th>
<th>Scalp:</th>
<th>Eyebrows etc.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anagen</td>
<td>2–3 years</td>
<td>4–7 months</td>
</tr>
<tr>
<td>Catagen</td>
<td>2–3 weeks</td>
<td>3–4 weeks</td>
</tr>
<tr>
<td>Telogen</td>
<td>3 months</td>
<td>9 months</td>
</tr>
</tbody>
</table>

2 main problems of hair:
Excessive hair: Hirsutism & Hypertrichosis (Hirsutism: ♀s Hypertrichosis: ♀s & ♂s) and
Loss of hair: Alopecia

HIRSUTISM OR FRAZONISM

Is the excessive hairiness on women in those parts of the body where terminal hair does not normally occur or is minimal e.g. beard or chest hair (male pattern of body hair ‘androgenic hair’); is of cosmetic and psychological concern. is a medical sign rather than a disease and may be a sign of a more serious medical condition, especially if it develops well after puberty.

Causes:
A- an increased level of androgens, the male hormones
B- an oversensitivity of hair follicles to androgens.

(Male hormones such as testosterone):
A- Stimulate hair growth, increase size and intensify the growth and pigmentation of hair.
B- High level of male hormones causes acne, deepening of the voice, and increased muscle mass.

Causes of hirsutism:
1- Polycystic ovary syndrome, (PCOs), (the most common), due to peripheral conversion of androgens to estrogen
2- Congenital adrenal hyperplasia
3- Cushing's disease
4- Growth hormone excess (Acromegaly)
5- Tumors in the ovaries or adrenal gland (cancer)
6- Medications: Androgen, Danazol & Progesterone
7- Insulin resistance
8- Stromal Hyperthecosis - in postmenopausal women
9- Obesity: due to peripheral conversion of androgens to estrogen
10- Familial
11- Idiopathic

Tests in hirsutism:
1* Ovarian ultrasound (high prevalence of PCOS)
2* Blood values:
   A- The androgens testosterone and dehydroepiandrosterone sulfate
   B- Thyroid-stimulating hormone (TSH)
   C- Prolactin
   D- 17-hydroxyprogesterone (because of the possibility of finding non classic 21-hydroxylase deficiency.

Treatment of hirsutism:
1- Pharmacological
   A- Spironolactone (Aldactone): Antialdosterone Antiandrogenic Compound, 100-200 mg/day for 6 ms
   B- Metformin:
   C- Combination oral contraceptives Cyproterone acetate (Diane-35 & Androcure): A progestin that has strong antiandrogenic action.
   D- Eflornithine: Blocks putrescine that is necessary for the growth of hair follicles.
   E- Flutamide: (oral 250 mg twice daily for 1 year): Androgen receptor antagonist is the most effective treatment but of higher side effects

2- Other methods
   A- Epilation       B- Waxing       C- Shaving
   D- Laser for massive hirsutism: is the most effective method of long-term
   E- Electrolysis (electrology) for few hairs

HYPERTRICHOSIS (ADAMS SYNDROME)
- Is a rare abnormal amount or excessive hair growth
- Affects children and both men and women
- Generalized or localized
- Congenital or acquired
- Causative Drugs are: Corticosteroids, Minoxidil, phenytoin, psoralens and streptomycin
Management:

1- Depilation methods:

2- Epilation methods:

3- Permanent hair removal uses
   A- Chemicals
   B- Laser hair removal
   C- Electrolysis

Removal of hair:

<table>
<thead>
<tr>
<th>Depilation</th>
<th>Epilation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the removal of hair from the surface of the skin.</td>
<td>is the removal of the entire hair strand, including the part of the hair that has not yet left the follicle.</td>
</tr>
</tbody>
</table>

Through Shaving with razor

Through waxing by using a sticky wax and strip of paper or cloth to pull hair from the root.

The hair grows back within hours of shaving; the new growth is called stubble.

The hair grows back finer and thinner compared to shaving within (5-9 weeks)

ALOPECIA

Alopecia: is loss of hair from the head or body

Causes and types:

1. **Chemicals** in hair relaxer & hair straighteners solutions, hot hair irons
2. **(AA)Alopecia areata**
3. **Androgenic alopecia (baldness)**
4. **Trichotillomania**: Compulsive pulling of hair,
5. **Traction alopecia** due to hairstyling routines,
6. **Telogen effluvium**
7. **Thallium poisoning**
8. **Underlying medical conditions:**
• iron deficiency or (side effects from drugs including chemotherapy, anabolic steroids, and birth control pills)
• Alopecia mucinosa, Diabetes, Dissecting cellulitis,
• Hereditary disorders, Hormonal changes,
• Hyperthyroidism and hypothyroidism, Hypervitaminosis A,
• Lupus erythematosus (LE), Radiation therapy,
• **Scalp infection**: Secondary syphilis, Tufted folliculitis
• Fungal infections (such as tinea capitis), Pseudopelade of Brocq,

**Diagnosis of Alopecia:**
• Based on clinical symptoms.
• If hair loss occurs in a young man with no family history, the physician should question the patient on drug and illicit drug use.

1- **The pull test**: Gentle traction is exerted on a group of hair (about 40–60) on 3 different areas of the scalp. If more than 10 hairs are obtained, the pull test is considered positive.

2- **The pluck test**: The root of the plucked hair is examined under a microscope to determine the phase of growth.

3- **Scalp biopsy**:

4- **Daily hair counts**: more than 100/day

5- **Trichoscopy**:

**Types of Alopecia:**

1- **Non-scarring (Noncicatricial) Alopecia**
   • Alopecia areata (AA)
   • Androgenic alopecia (male pattern baldness)
   • Telogen effluvium (Handful hair loss)
   • Thallium poisoning:
   • Miscellaneous Hair disorders: Traction alopecia, Trichotillomania
   • Alopecia due to structural defects of hair

2- **Scarring (Cicatricial) Alopecia**: Pseudopelade of Brocq

1- **NON-SCARRING (NONCICATRICIAL) ALOPECIA:**

**ALOPECIA AREATA (AA): (SPOT BALDNESS)**

Not contagious, reversible, sudden (abrupt), patchy well circumscribed loss of hair with **Exclamation mark hair**! Most often affects the scalp and beard area in 1 or more round or oval spots, but may occur on any hair-bearing part of the body. Affects 0.1%–0.2% of the population. Affects both healthy males and females.

**Common in children.** Most commonly occurs in the late teenage years, early childhood, or young adulthood, but can happen with people of all ages.

**O/E: on examination:**
   • Typical first symptoms of AA are small bald patches.
• Skin of AA is unscarred and looks superficially normal.
• Areas of hair loss over a short period of time and regrowth at the same time & may go into remission for a time, or permanently.
• Regrowth may be with white colored hair
• May tingle or be painful.
• Commonly more on 1 side of the scalp than the other.
• **Exclamation point hair !:** is characteristic sign (narrower hairs along the length of the strand closer to the base) & is often present.
• Hair will tend to pull out more easily along the edge of the patch than away from the patch where they are still healthy
• Nails may have **pitting or trachyonychia:** (rough accentuated linear ridges (longitudinal striations).

**Causes of AA**

The cause is unknown. Heredity may be a factor.

**Associations:**

1. Goiter, myxedema, Hashimoto’s thyroiditis
2. Vitiligo, lupus, rheumatoid arthritis, pernicious anemia, inflammatory bowel disease, myasthenia gravis, lichen planus or HIV infection
3. Down’s syndrome, Turner’s syndrome and autoimmune polyglandular syndrome may develop AA
4. Tends to have a slightly higher incidence of the immune system conditions: asthma, allergies, atopy and hypothyroidism.
5. Other autoimmune diseases

**Types of AA:**

• Diffuse AA: Hair is lost diffusely over the whole scalp
• AA monolocularis: baldness in 1 spot anywhere on the head
• AA multilocularis: multiple areas of hair loss.
• AA barbae: limited only to the beard
• Ophiasis: severe marginal AA
• Sisaphio: reverse ophiasis: hair loss limited to the top, center and vertex of the scalp, sparing the margins
• Alopecia totalis: the patient loses all the hair on the scalp
• Alopecia universalis: all body hair, including pubic hair, is lost
• AA totalis and universalis are rare: only in 1–2% of cases

**Diagnosis of Alopecia areata:**

diagnosed based on clinical features.

**Trichoscopy:** shows regularly distributed “yellow dots” (hyperkeratotic plugs), micro-exclamation mark hairs, and “black dots” (destroyed hairs in the hair follicle opening).
Biopsy is rarely needed in AA.

Histologic findings: peribulbar lymphocytic infiltrate (swarm "great number" of bees).

Treatment

Small AA: observe as often spontaneously the hair may grow back.

In severe AA:

Corticosteroids:

a. Corticosteroids injections
b. Steroid cream: Elocom ointment
c. Intrallesional steroid injections are commonly used in sites where there are small AA of the scalp or eyebrow

Minoxidil

Irritants (anthralin or topical coal tar)

Topical immunotherapy cyclosporine

Oral corticosteroids (have serious adverse side effects)

Tacrolimus ointments such as Protopic for AA of beard area

Wigs are often used in AA totalis

AA is of poor prognosis in:

• Young age at onset
• Extensive early AA (ophiasis: severe marginal AA)
• Associated atopy
• Positive family history
• Autoimmune disorder
• Associated nail changes

Prognosis of AA

• The course of AA is 6months – 2 years
• In most cases: AA with small number grows back after a few months to a year.
• AA with a greater number of patches, AA grow back or progress to AA totalis or universalis.

Effects of AA are:

• Psychological (mainly)
• The scalp burns more easily in the sun.
• Patients may also have aberrant (abnormal) nail formation because keratin forms both hair and nails.
• Episodes of AA before puberty predispose one to chronic recurrence of AA.
**ANDROGENIC ALOPECIA (MALE PATTERN BALDNESS)**

- Is the **most common cause** of alopecia in men & women
- "**Hippocratic balding**: hair is lost & thins above both temples and at the crown of the head (Often a rim of hair around the sides and rear of the head is left and may rarely progress to complete baldness)
- In women the hair becomes thinner around the whole scalp, and the hairline does not recede.

  **The cause** is unknown:
  - **Genetic factors** apparently play a role
  - It is caused by a genetic sensitivity of hair follicles to DHT (dihydrotestosterone) which causes follicles to shrink or "miniaturize" and hair loss
  - **Androgens** have functions of regulating hair growth and sex drive in both males and females.

  **Treatment:**
  - Many people accept their hair color or shape,
    1. Minoxidil solution 5% for males and 2% for Females
    2. Finasterides (Propecia) 1mg/day
    3. Hair transplantation

**TELOGEN EFFLUVIUM (TE): (HANDFUL HAIR LOSS)**

- Normally there are 100,000 hair follicles on the scalp.
- (50-100) club hairs are shed daily from a normal scalp.
- **TE is thinning/shedding of scalp hair** resulting from the early entry of 70% of hairs into the telogen phase and causing a noticeable loss of hair, caused by:
  - Emotional or physiological stressful events, eating disorders, fever, childbirth (pregnancy), chronic illness, major surgery, anemia, crash diets, hypothyroidism, and drugs.

**Thallium poisoning:**

- **Thallium sulfate** is a colorless, tasteless and odorless solution used for rat poison, ant killer and is used for suicide, homicide and genocide.
- **Thallium** may be detected in body fluids as blood or urine even up to 6 months after the poisoning as a diagnostic tool in clinical poisoning situations or to aid in the medicolegal investigation of suspicious deaths.
- Causes death or neurological deficit and alopecia in survivors

  **Treatment:**
  - Antidote is oral (Prussian blue) 20 g per day; it passes through the digestive system and comes out in the stool.
Hemodialysis and hemoperfusion

At later stage of the treatment additional potassium is used to mobilize thallium from the tissue.

Thallium was the poison of choice for Saddam Hussein to use on dissidents, which even allowed for them to emigrate before dying. Muharram Muhammed Amin, where is he? Shakir Fattah, where is he? And others???????????????

### Treatment of Alopecia:

**Minoxidil (Rogaine) liquid or foam:**
- Only used for androgenetic alopecia and alopecia areata.
- Is rubbed into the scalp twice a day.
- Only 30–40% of patients experience hair growth.
- Hair regrowth can take 8 to 12 months.
- If the treatment is stopped, hair loss resumes again.

**Finasteride (Propecia) tablet: 1 mg/day**
- Is used in male-pattern hair loss
- Is not indicated for women and pregnant.
- Is effective within 6 - 8 months of treatment.
- Side effects: decreased libido, erectile dysfunction, ejaculatory dysfunction, gynecomastia, and myopathy.
- Should be continued as long as positive results occur.
- Once treatment is stopped, hair loss resumes again.

**Egg Oil:** nourishes the scalp

**Intralesional Corticosteroids injections** monthly used to treat AA

**Anthralin (Dritho-Scalp)** cream or ointment applied to the scalp

**Hormonal modulators:** Oral contraceptives or antiandrogens (spironolactone and flutamide used for female-pattern hair loss with hyperandrogenemia.

**Surgical options:** Hair (follicle) transplant, scalp flaps, and alopecia reduction

**Wigs:** can be used permanently or temporarily to cover the hair loss.

### MISCELLANEOUS HAIR DISORDERS

**Traction alopecia:** is caused by pulling force applied to the hair. e.g. Afrocaribbeans

**Trichotillomani:**
- Is Hair Pulling Maddness: is (impulse control disorder)
- More in females and children
- O/E: an ill-defined patch with twisted and broken hair usually at frontoparietal scalp

**Treatment:** is based on a person's age.

- **before 5 years of age:** the condition is typically self-limiting and intervention is not required
• In young adults: behavior modification + chlorpromazine (Anafranil), a tricyclic antidepressant,

ALOPECIA DUE TO STRUCTURAL DEFECTS OF HAIR:

Trichoptilosis (split ends): hair are split and feathered

Pili multigemini is a malformation characterized by the presence of bifurcated or multiple divided hair matrices and papillae, giving rise to the formation of multiple hair shafts within the individual follicles.

Trichoclasis: Transverse split in hair with retained cuticle

Trichoschisis: Smooth Transverse split in hair

Trichorrhexis nodosa: Longitudinal splitting of shaft, frayed ends are like 2 paint brush pushed into each other causing nodules along the shaft.

Trichonodosis: Knots and loops in shaft.

Trichorrhexis invaginata (Bamboo hair): Distal shaft pushed into bulbus receptacle on proximal shaft as in Netherton syndrome

Pilus torti: Twisting of hair along its long axis

Monilethrix: Shaft has alternate swellings and constrictions (beaded effect)

Pseudofolliculitis barbae:

• in beard area of black men
• caused by close shaving in curly or kinky hair that may cause the newly emerging hair shaft to grow back into the skin surface causing inflammation.
• O/E: papulopustules, hyperpigmentation and scarring

2- SCARRING (CICATRICIAL) ALOPECIA:

Destroyed hair follicle replaced with scar tissue, and cause permanent hair loss.

Causes:

1. Aplasia cutis congenita, EBD, Incontinentia pigmenti, Porokeratosis of Mibelli, Darier’s disease & Ichthyosis
2. Mechanical, Chemical, Thermal & Radiodermatitis
3. Tinea capitis, Bacterial folliculitis, folliculitis decalvans Acne keloidalis
4. Pseudopelade of Brocq, Lichen planus, DLE, Lichen sclerosus et atrophicans
5. BCC, SCC, Lymphoma
6. Morphea, Facial hemiatrophy, Dermatomyositis, Necrobiosis lipoidica, Sarcoidosis, Pyoderma gangrenosum, Syphilis, Tb, leishmaniasis, Herpes zoster & Ecthyma

Pseudopelade of Brocq:

The cause is unknown. due to atrophy of the hair follicles. Reddish skin erosion with a sharp margin, raised borders and large permanent patches of scalp alopecia.

Single or multiple, Smooth, Soft, Slightly depressed, Round or oval, Asymptomatic, Not scaly, Hairs easily pulled from the edges if active. Treatment: Surgery.