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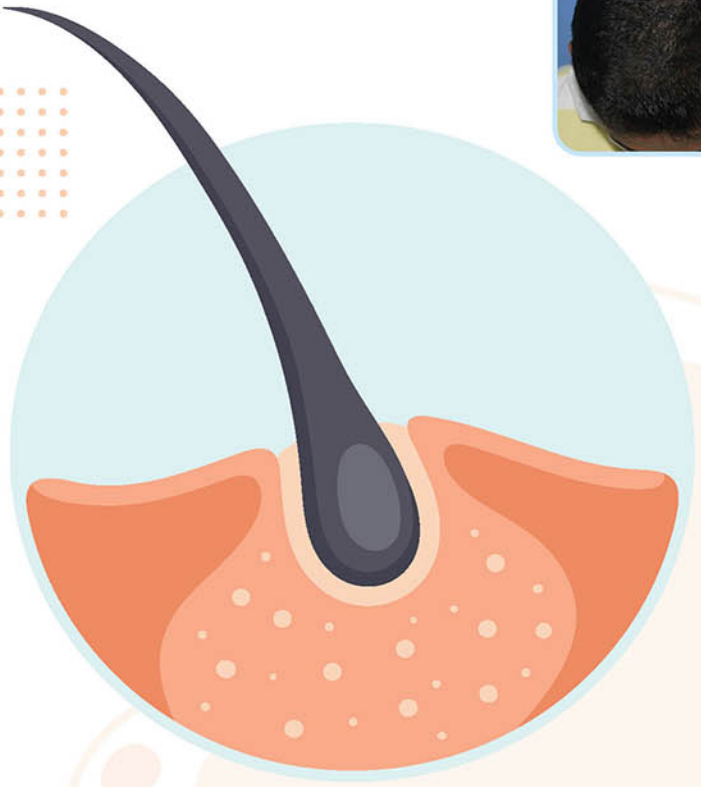
HAIR TRANSPLANTATION





2nd Edition



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CHAPTER

2

Naked Ape

Anvitha C, Venkataram Mysore

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Key Messages

- Human beings are the only primates without thick body hair.
- Evolution has played its part in reducing the thickness and density of body hair from our prime ancestors.
- It is indeed intriguing that while nature prefers the *Homo sapiens* to be relatively naked and hairless, the *Homo sapiens* is so obsessively fascinated with the preservation of persistence of hair.
- Understanding of the journey might help us in the preservation of hair in generations to come. These issues are indeed very relevant for all physicians who treat hair, such as dermatologists and hair transplant surgeons.

INTRODUCTION

Homo sapiens, having evolved from apes, exhibits many dissimilarities from their ancestors, with nakedness being the most prominent. It is evident that the main difference does not just lie in the quantity of hair, but also in the quality of it.

There are several theories for human hairlessness.

Aquatic ape theory contributes to the understanding of human nakedness.[1,2] According to this theory, the change in body hair was secondary to prolonged exposure to an aquatic environment. In ancient times, our ancestors were ridden with external parasites. Hence, Pagel and Bodmer[3] suggested that human nakedness came into existence to rid the former of these parasites.

Another reason for human nakedness could have been a way of dealing with excessive heating, according to some other theories.[4] The excessive heating might have been due to a change of diet (meat) and place. No substantial evidence is available to suggest a change of diet.[5] Harris[6] was of the opinion that parents were happier with hairless babies as compared to hairy ones (who were abandoned or killed).

Darwin's[7] theory introduced the idea that human nakedness evolved as a sexual feature where males were aroused by the lack of hair in females. However, this does not explain why the females denounced a hairy body. The above theories cannot explain the complete reason for the evolution of the feature of lack of hair.

Three major human characteristics, which have a bearing on the puzzle of nakedness of humans, need to be explained:

1. *Upstanding hominid*:[8] Upright bipedalism appears to be a significant characteristic that separates it from other primates. The turning point for the primates to evolve into humans is the ability to walk on two legs. No concrete theory has been put forth to explain the genesis of bipedalism. A lot of theories were introduced to explain the need for humans to adapt to walking on two legs and standing up straight. Here are a few:
   a. It helped them to keep away from wild animals and protect themselves.
   b. It helped them to rummage for food.
   c. It helped them to preserve their energy when compared to walking on four legs.[8]

   The ability to walk on two legs and stand up straight might have been triggered by a single mutation, which might have also been responsible for the loss of human body hair.[9]
2. *Reduction of body hair*:[8] The major function of body hair in primates was for the baby to hold on to the mother when she moved around.[8] The evolved bare

humans were forced to hold the baby with both hands as there was no hair for the baby to hold onto. Based on these observations, it can be postulated that the changes that happened were interdependent.[8]

3. *Concept of family*: One more unique characteristic feature of hairless humans was the introduction of the concept of society, family, etc. It is possible that the genesis of this feature is connected to the origin of others, i.e., standing up straight, walking on two legs, and having a hairless body.[9] The primates were polygamous, lacked a social mindset, and had intercourse only during a specific time of the female menstrual cycle. But with humanization, the social and reproductive unit of family was introduced, which slowly led to the formation of society. The males in the newfound society were monogamous and did not restrict intercourse only for reproduction.[8]

It is a common understanding that humans originally came from Africa.[10,11] The first few ancestors belonged to the genus *Ardipithecus* that mainly lived in forest areas.[12] The descendants of the former, called hominids belonging to the genus *Australopithecus*, inhabited different kinds of territories while their origin was still limited to Africa.[13] According to some studies made by paleontologists, it can be postulated that the ice age began on this earth 26 lakh years ago, which significantly altered the living conditions of the hominids.[14] In accordance to the change in the living conditions, the hominids learned to make tools and weapons out of rocks in order to slay animals.[14] In order to hunt the animals which were the only and richer source of nutrients, the descendants of the hominids that belong to the genus *Homo* developed ways of walking and running long distances through the development of a present human-like skeletal structure.[15] As a consequence of long-distance walking came excessive sweating, which resulted in overheating and the need for reducing body temperature. From the above observations, it was apparent that walking on two legs increased its efficiency in moving faster and using tools. 16 lakh years ago, it was found that *Homo erectus* was the earliest hominid to have long limbs that helped them to move better. Around the same time, human nakedness set in which helped reduce the body temperature.[4]

Hairlessness and melanin: The development of human nakedness led to some disadvantages like the loss of protection against sunlight, which was a great disadvantage as the hominids inhabited regions receiving high ultraviolet (UV) radiation, i.e., the Savannahs.[16] The loss of hair led to the damage of skin due to a drier environment. The higher exposure to UV radiation led to cutaneous malignancies and malfunctioning of the epidermal layer of the skin, which in turn led to an increased need of vitamins such as folic acid.[16] Folic acid is required for the repair and production of deoxyribonucleic acid (DNA) and for the formation of blood cells.[16] But this folic acid disintegrates on exposure to UV radiation as demonstrated in patients of Fitzpatrick skin types 1 and 2. Hence, evolution resulted in the formation of melanin.[17]

As humans migrated away from the equator, the intensity of the UVB rays reduced and this led to insufficient production of vitamin D.[16] Melanin, when present in higher concentration, led to slower production of vitamin D and thus insufficient production of vitamin D, leading to rickets. Rickets is a condition in which there is insufficient mineralization of the bone, leading to malformed bones, a serious complication of which was unsuccessful birth of babies.[16] In 1930, there was a health drive that underlined the importance of vitamin D in the diet, which proved to be important, as a study done in 1956 showed that 14% of the women had deformed pelvises due to vitamin D deficiency.[18] The death rate of the fetus and the maternal mortality rate had increased due to the increased occurrence of the deformed pelvis.[18] During pregnancy and lactation, the requirement for vitamin D increased, which evolutionarily encouraged a lighter skin tone among females.[17] Another reason that led to the amplification of vitamin D deficiency was the introduction of clothes. The behavior of head lice and body lice has helped us to estimate the initial use of clothing. These two lice resemble each other structurally but feed on different body parts. Head lice that live on the scalp feed more when compared to body lice that happen to feed less due to the obstruction caused by clothing.[19] Initially, only the head lice were present, which inhabited the scalp. But due to the introduction of clothing,[20] it restricted the surface of the body for feeding, which led to the evolution of lice into two types: Body and hair lice.[21] Hence, the evolution of human nakedness, in part, led to this emergence of two different types of lice.[22]

There was another theory put forward by Belt[23] that introduced the idea that human nakedness happened to diminish the load of parasites that inhabited the human body surface. Since humans had settled down in fixed places and lived in groups, the chances of ectoparasite infestation were very high. Thus, hairlessness helped them identify the parasite on their skin and aided in their removal.[23]

Persistence of hair in some places: The plausible reasons for persistence of hair in some places on the human body are worth pondering over. It was postulated that areas such as armpit and pubis required more moisture during movement as they were prone to friction.[4] However, this was not convincing as hair in these areas grow only on the onset of puberty, while children up to that age tend to do

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quite well without the same. This theory also does not hold good in regards to the location of pubic hair, i.e., on and around the genitalia but not in between the legs.[24]

Thus arises the question about the more probable function of this hair, which may be to hold on to the secretion of the glands of the areas. Wyatt[25] proposed that pubic and underarm hair served the function of differentiating between individual and prospective mate selection.

The other location of interest is the scalp hair. It appears that scalp hair protects the top of our head from extreme heat. Considering this, it is difficult to explain the incidence of androgenetic alopecia (AGA). It is also difficult to correlate the varying lengths of hair in males and females with this scalp hair function. Considering that scalp hair was preserved for body temperature regulation, the patient suffering from male pattern baldness does not seem to suffer from overheating. AGA seems to be increasing in incidence and prevalence. Female pattern baldness is, however, not as common as AGA. This variation is probably because scalp hair may be more of a feature of sexuality. The supporting factor for the same is the presence of beard and mustache hair in males, which is linked to male sexuality. It appears that the increased length of hair in females is akin to that of a belted kingfisher and can be primarily considered as a sexual feature. Since long hair was preferred in females and was genetically selected, it may have passed on to the males through genetics and leaves as much function as the nipples in males.

The enigma that is pattern baldness—AGA: The etiology of AGA remains a mystery till date, despite much research. Various hypotheses have been proposed.

Androgenetic alopecia seems to be more of a hormone-related condition. The hormone is most probably dihydrotestosterone (DHT). This hormone gets collected within the hair follicles of the scalp. Testosterone is converted to DHT by the enzyme 5-alpha-reductase (5a-R). This accumulation of DHT causes the hair to miniaturize over subsequent hair growth cycles,[26] probably by reducing blood flow to the hair follicle.[27] Over time, this leads to balding. The genetic role seems to be prominent in AGA, and quite a few genes have been labeled as the cause of the same. They include *STU1*[28] (receptor gene), 5a-R types 1 and 2 (*SRD5A1* and *SRD5A2*, respectively),[29] *CYP1744*, etc.

Another hypothesis has been put forward for the causation of AGA, called the skull expansion hypothesis. It proposes that a few specific parts of the cranium do not stop their growth even in adults prone to AGA. According to this, miniaturization of terminal hair in AGA is a result of decreased blood flow and nutrients to the frontal and parietal areas of the scalp as a direct consequence of the narrowing capillary blood vessels serving the areas, due to the progressive stretch on the scalp tissue, imposed on it by the frontal and parietal bones.[30] It also links the role of androgens to bone modeling. Androgens, including DHT, act to increase male bone deposition during the growth phase. The triggering of the new bone to grow and expand in the skull happens in the individuals prone to AGA.[30] Osteoblasts and osteocytes contain androgen receptors and 5α-R enzymes. Consequently, DHT triggers the multiplication of osteoblasts, which in turn leads to the formation of new bone.[31] The frequency of AGA in females is lesser when compared to males. This can be attributed to the fact that females have higher estrogen levels and lower testosterone levels.[32] Estrogen, unlike testosterone, decreases bone resorption.[33] As with all other bones, the parietal and frontal bones will be smaller in females, compared to males.[34] In a healthy premenopausal female, the estrogen level exceeds that of testosterone, and hence there are lower chances of skull expansion. But in cases where estrogen levels are low [e.g., polycystic ovarian disease (PCOD), menopause], male pattern baldness may be seen.[35] The shape of the skull and its potential to grow and expand are all genetically determined. Those who have a genetic predisposition toward AGA[26] will have greater potential for skull expansion. In patients who have AGA, this new bone growth, when triggered by increased levels of DHT, will expand the skull far beyond the ability of bone resorption.[30] The shape of the cranium and the ability for growth of the bone can explain the differences in the location of baldness happening on the frontal and parietal areas of the scalp.

Occipital sparing in AGA: The variation of hair over different parts of the scalp is dependent on hormone-related properties and differing structure of the scalp in patients having AGA.[36,37] The hair follicles in the occipital area of the scalp respond poorly to testosterone-related cellular response.[37,38] The concentration of androgen receptors and 5a-R enzyme is more in the frontal area of the scalp as compared to the occipital area for males and females.[39-42] Studies have also demonstrated higher levels of the enzyme aromatase, which is responsible for converting testosterone to estrogen in the occipital area in both genders.[36,39,43] The above qualities of the occipital area are because of its embryological origin. The embryological origin of a large part of the head in vertebrates is of the neural crest, while the posterior part of the head containing the occipital region originates from the mesoderm.[44] This may explain the different behavior of occipital scalp hair.

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SUMMARY

What does this change in the thickness and length of hair signify? What is its role in the process of evolution? Does it imply that the future generations will have thinner and shorter hair and eventually none of it? It is crucial to understand the theories of hairlessness and ponder on their implications.

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