



Cultural evolution as a possible triggering or causative factor of common baldness

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Summary Common baldness (alopecia) increasingly affects a higher number of individuals at earlier ages, independently of gender. One of the reasons could be lack of knowledge concerning its etiology. The human being has evolved to become a naked monkey, although there is no apparent reason to continue the evolutionary process up to becoming a bald monkey. According to this theory, common baldness is a degenerative process derived from certain inadequate cultural practices, such as excessive hair cutting or certain types of haircuts that prevent contact among hairs themselves and limit outside contact in ways that would alleviate balding. Blocking the flow of sebum towards the base of the hair follicle – and so interfering with the arrival of the stem cells to the dermal papilla with consequent hair miniaturization – ends up being the first negative physiological effect derived from certain cultural habits. As time goes by, other mechanisms become altered, which leads to a less and less reversibility of the process.

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Introduction

It is generally accepted that loss of memory in people over 60 years of age is mainly due to cultural factors [1]; that is to say, the viability or destruction of determined neurons is due to certain behaviours of the individual. This process could be similarly related to the problem of common baldness.

Human ancestors in the African savannah, over 3.5 million years ago, adopted bipedism as a step towards evolution. In such way, the human being improved his watching possibilities over the high grass. His hands got rid of the locomotion process and, this way, he had better access to feeding re-

sources that had been formerly unreachable. Such upright walking modified our hair. We gradually eliminated and miniaturized our body hair, while our scalp hair grew longer and denser to improve the thermal isolation of the brain. In parallel, body hair loss avoids excessive hosting of parasites and, consequently, the time invested in peer hygiene is reduced in favour of practicing some other cultural habits.

Human hair is the most evolved type of hair in any species. The pilosebaceous unit consists of the hair shaft, outer and inner sheaths, the dermal papilla, the sebaceous gland, the erecting muscle, the vascular system, the annex nervous system, and the bulge region that provides stem cells for epidermis and hair regeneration. Any hair shows a cycle with an anagen (growth) phase followed by a catagen (resting) phase and a telogen (fall out)

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phase after which the process starts again. Moreover, the determining and characteristic feature of the human hair is its asynchrony; that is to say, its autonomy to self-regulate its own hair cycle independently from the hairs next to it [2]. This unique trait allows us to shed our hair without realizing it, retaining our image, which eases other's recognition of us and consequently our recognition of others, taking a huge step towards the species' cultural evolution.

The pilosebaceous unit is among the most complex mechanisms of the human body and provides a location where most of the biological systems intervene, which makes the study of human hair a huge puzzle. The primitive germs of the pilosebaceous unit are exclusively formed during embryo development, one of the crucial stages for physiological development. On the human body, apart from those specialised forms comprising eyelashes, eyebrows, ear and nose, two types of hair grow: that which is in the scalp and the corporal or body type. Scalp hair starts growing immediately after birth. Body hair is mostly delayed until puberty when the body begins preparing itself for reproductive tasks.

Hair loss might be caused by a great number of factors that usually affect hairs diffusely, in a general rather than localised way. The difference between common baldness and other hair loss phenomena lies in the fact that it only affects certain regions of the patient's scalp. Some researchers have tried to discriminate different types of hair on the scalp. The problem is that these differences have been only observed in individuals affected by common baldness, but they have not been corroborated in healthy patients [3]. Techniques of hair transplantation are often cited as evidence of the genetic differences among hairs on the scalp, but nowadays the concept of donor dominance of donated hair over resettled areas is uncertain [4]. It is not only questioned but many experts agree that the most effective way to surgically fill in "resistant" hair is scalp reduction of the areas affected by removal of bald scalp and closing the adjacent areas together, although even this effect is often temporary. All these factors lead me to think that there are not different types of hair on the scalp and that control mechanisms are the same in women and men. Strong reasons would be necessary so that nature evolved different hairs on the scalp.

Baldness classification scales in both women and men have been modified and interwoven as investigations have advanced. The number of cases of common baldness in male patients suffering hair loss similar to female patients is rising [5], as are

the numbers of females suffering male pattern baldness.

Theory

At the beginning of the 20th century, the French dermatologist Raimond Sabouraud talked about the relationship of baldness and seborrhoeic problems [6]. Sebum production by the sebaceous gland is critical for hair and epidermis health. Sebum is mainly formed by triglycerides and wax esters, both unstable materials susceptible to oxidation and which must be renewed continuously. This need to create and to eliminate sebum makes it flow through a centrifugal track impregnating all the surfaces running both outwards from and inwards toward the hair follicle. In the author's opinion, the central hypothesis is that sebum components not only are discharged to the skin surface but also exert effects on the lower/proximal hair follicle, including even the anagen hair bulb and its dermal papilla. Although the inward flow is not supported yet by bibliography, there are facts that suggest it, such as the observation that sebum is accumulated at the base of the hair follicle in damaged hair, proving that sebum has reached this area. Moreover, it has been acknowledged that within the hair medulla the highest concentration of lipids is found and that its chemical composition is very similar to that of sebum [7,8].

The inward directional flow is not easy, since the pathway is narrow and sebum must slide between the epidermis connective tissue and the outer root sheath of the hair. Once the path is chosen, the sebum must necessarily arrive at the end of the dermal papilla. There is no possible way back. Blocking this sebum flow toward the inner hair follicle seems to be the initial triggering cause of the common baldness degenerative process (Fig. 1).

At this point the key question would be: why is the flow of sebum at this area eventually blocked? The only plausible reason for biologically causing the obstruction of sebum flow would be a drastic increase of the inward sebum flow. Talking in economic terms, when the demand of a product increases or decreases disproportionately, there appears the risk of destabilisation for the rest of products. If the imbalances persist for a long period, costs go higher. In a similar way, if the assimilation of outwards sebum is interrupted, it is very likely for the inwards flow of sebum to be altered as well.

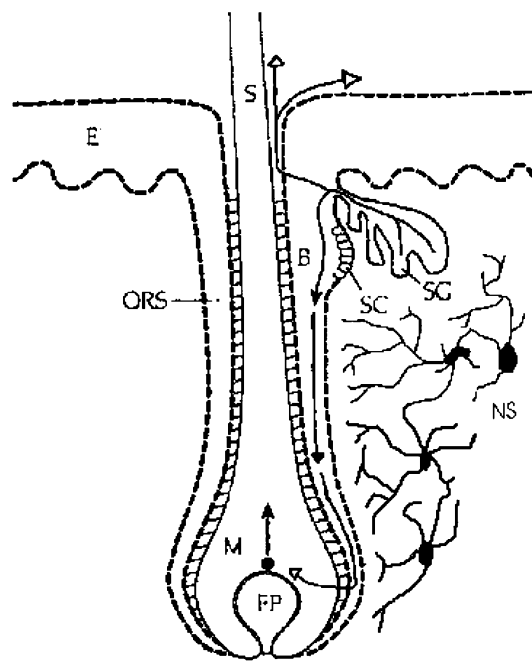


Figure 1 Eschematic Diagram of Pilosebaceous system/unit. Due to the easy oxidation of the sebum produced by the sebaceous gland, the latter must be created and eliminated continuously. A small part of the sebum produced will make its way through the base of the hair follicle. Blocking of the sebum flow could represent the trigger cause of common baldness. B – bulge; E – epidermis; FP – follicular or dermal papilla; M – matrix keratinocytes; NV – nerve system; ORS – outer root sheath; S – hair shaft; SC – stem cells; SG – sebaceous gland.

hormonal, immunological, circulatory and neuronal systems, making the process less and less reversible.

Cultural observations

This theory can provide a satisfactory explanation for the different percentages of common baldness affecting different people, depending of the type of hair they have. The most susceptible individuals to suffer from baldness will be those who cut their hair excessively short, whose hair is thin, straight or with low hair density. On the contrary, it is very difficult that individuals with high hair density and thick hair suffer from baldness, even if they wear short hair.

This theory also would clearly explain why the incidence of common baldness is different in both sexes, and it is due to the fact that women usually wear longer hair than men. However, it must be mentioned that nature provides both sexes with the capacity to have long hair. It is not something exclusive to the female gender. Long hair allows the elimination of sebum, even in the hair located at the top of head, since sebum can move in a longitudinal way along its surface till it reaches the absorbent surface. Similarly, it can be explained why there is less repercussion in people with a high hair density, or with thicker or curly hair, since these physical characteristics of hair influence the favouring or impedance of sebum outward flow. The theory explains why certain ethnicities or cultures such as Native Americans, rastafaris, gypsies, etc. do not suffer from common baldness. However, the contrary example would be those women who suffer from baldness since they cut their hair shorter due to aesthetic reasons (especially the part of the "fringe" or "bangs" over the forehead area). Such is the case of the cultural groups like the Zo'e or the Yomibato in the Amazon jungle or the Palawans in the Philippines.

Many people affected by common baldness have noted that they started to suffer from it during military service. This theory could explain this fact. The difference in hair length is the key. Military people, skinheads and others wear their hair short and therefore they can induce problems with the sebum flow. On the contrary, hippies, Hindus, etc. wear long hair. Therefore while some of them are susceptible to suffering from baldness, others are not.

This also explains why it is so easy to induce alopecia at the crown area with what is called tonsure, a practice undertaken by certain religious

Sebum has two ways of being eliminated toward the outside. One is a longitudinal way, sliding through the hair shaft (from the base of the hair shaft to the tip of the hair), and the other one is a transverse way, transferring it from one hair to its neighbour (more remarkable if the hair density is higher). The sebum produced is continuously eliminated by combing, washing, brushing the hair, touching or massaging it or even while we rest our head in an armchair. However, the most important and recurring agent accomplishing this function is the bed's pillow, as it is an absorbent surface able to eliminate the sebum. (Human beings spend one third of their existence sleeping.) It is interesting to underline that no baldness happens in areas where this drainage cannot be interrupted. All these factors lead to the idea that lack of contact with an absorbent surface firstly causes the problems related to sebum drainage.

In my opinion, the triggering cause of the process of alopecia is the detention in the sebum flow moving towards the root of hair. Such a simple fact brings with it an alteration of all the biological,

orders, since they isolate certain hairs in such a way as to stop sebum flow.

Biological observations

As has been mentioned, sebum is an agent susceptible to oxidation, and during this process the quality and its composition are modified, increasing its viscosity and compactness, altering the acidity of the environment and modifying its biological signals. Common baldness is a degenerative process, and blocking the sebum flow seems to be the trigger that leads to a chain reaction process. These posterior facts have been often considered as causal elements in baldness, but arguments have failed when trying to prove such theories. They have been proven to be side effects that increase the problem's seriousness and that might make it less reversible.

A very important detail to take into account is the fact that sebum carries biological signals such as androgens and stem cell, which are created in the bulge area. (Notice its location just below the sebaceous gland duct.) Blocking the inward-flowing sebum seems to provoke a series of effects such as:

- Blockage of physical material that feeds the hair shaft. Apparently sebum does not reach the hair dermal papilla.
- Blockage of certain biological signals such as our own sebum substances or the information carried thereby. When the quantity of sebum is increased, the amount of hormonal components grows as well, especially dihydrotestosterone (DHT) and an excess of this substance seems to produce negative effects upon hair growth, parallel to an increase of the production of the sebaceous gland.
- Increase of microorganisms fed from sebum lipids. Such an increase can provoke the body's immune reaction of rejection. Nowadays it is commonly accepted that pilosebaceous units do belong to the immune system.
- Decrease of the production pace and blockage of stem cells, preventing arrival to the dermal papilla, leading to the process of hair shaft miniaturization in all cases of common baldness [9].
- The blockage of sebum flow provokes oxidation and an increase of free radicals and higher sebum viscosity. This phenomenon may alter its composition qualities and consequently, different kinds of rejection are more likely to happen.
- Due to action of lipoxigenases, free fatty acids appear and their peroxidation leads to neuro-

prostanes that cause death by apoptosis in the neural system. The author postulates that something similar happens in the hair system [10].

- The tissue next to the hair loses vascularisation and the amount of sebum increases in the areas around the hair root and the latter is likely to suffer episodes of inflammation. Such inflammation of the tissues makes the way narrower and further hinders the mobilization of the sebum.
- Stem cells leaving the bulge region will not reach their initial destiny and their pluripotentiality allows them to create different cellular tissues as keratinocytes, provoking fibrotic processes around the hair follicle.

All these processes can happen one after the other one or in a parallel way. The process of common baldness becomes more complicated and difficult to reverse.

Scientific data and pertinent trials

It must be admitted that hard data trying to find the joint link between common baldness and hairstyle are practically nonexistent, despite the great number of facts that can be observed in daily life. This might be due to the fact that science does not mesh with the always-changing dictates of fashion, which are part of human cultural evolution. But in order that a hypothesis can be turned into a theory, it must fulfill the minimum requirements of the scientific method, and one of these is that the investigator can reproduce and repeat the results. The question would be: Is it possible to induce common baldness in healthy individuals? Nowadays there are many ways to cause hair loss, as it could be due to drug side effects (for example chemotherapy), serious deficiencies of nutrients, post-traumatic or even very stressful situations. But all these causes lead to a generalized loss of hairs, not just to part of them as happens in the case of common baldness; and on the other hand, once the causative agent is eliminated, hair is usually recovered in a natural way. My hypothesis should prove that specific areas of alopecia are caused just by hindering the normal elimination of sebum. Shortening the length of hair is enough to stop the longitudinal flow of sebum, but in order to stop the transverse flow among hairs, it is necessary to cut hair even shorter; that is, to shave it in order to get a total isolation of hair, even if it is thick with high hair density. Therefore, tonsure becomes the appropriate tool, and its practice proves us the high efficacy of this method. A similar reasoning would

be able to explain the great number of people with receding hairlines, probably due to an excessive cut of the hair at the front area.

On the other hand, my hypothesis would be strengthened if it were proven impossible to induce baldness in areas that are usually preserved. Fortunately, daily observations give examples in this sense. A very clear one would be bald individuals who decide to shave their heads. They must do it daily because they are not able to eliminate the hairs at the sides. This fact is probably due to the impossibility of stopping the sebum flow, since at these areas the pilosebaceous follicles can drain sebum in a direct way to an absorbent surface through repeated contact while we sleep.

Another very important detail is that tonsure was also practiced on novices, some of them before puberty. It can be found even on girls and women, with the same inexorable results: the appearance of a bald area in all the cases. These facts seem to point out that in order to make a bald area, it is much more useful to negatively modify the elimination of sebum rather than the general hormonal influence of people. In brief, it seems that tonsure is a universal method to produce a localised alopecia on any person.

Conclusion

According to the theory, common baldness is a degenerative process derived from certain inadequate cultural practices. This phenomenon is observed in both men and women and it affects a greater number of individuals nowadays, but it seems easy to prevent just by growing hair long enough to prevent the loss of contact among hair shafts and the outside, and this way, maintaining the outward sebum flow. However, once common baldness exists, the process must be stopped or hair loss is unavoidable. As time goes by, the processes increase and they become less reversible. So there is a paradox: it is useless to try to recover hair lost during the past years while it could be very easy to prevent its loss. Therefore, prevention appears to be the most suitable solution.

This theory has some points to be stressed:

- It tries to make clearer the initial and triggering cause of common baldness, which is the same in men and women regardless the localization of the hair in the scalp. It does not distinguish alopecia areata, receding hairlines, etc.
- The theory gives relevance to the sebum and its foundations, supporting the general opinions of

the people who suffer common baldness: those people realized that in a determined stage of common baldness, there is a sebum alteration over the scalp. As a result, this theoretical development restructures the old theory of "clogged follicles" and gives relevance to baldness caused by seborrheic dermatitis.

- In case this theory were confirmed, the importance of the genetic component in common baldness would be reduced. Genetics determines the type of hair, predisposing to common baldness in individuals with thin and low density hair, but it does not destine irremissibly these people to develop baldness. Therefore, by modifying a specific component of cultural evolution – in this case a fashion – the problem in question could be solved in an effective and preventive way.
- Besides the entire body of supporting scientific evidence, I would like to mention Occam's razor: "Pluralitas non est ponenda sine neccesitate," and its corollary: Given more than one theory or solution to a problem, it is much more interesting and fruitful to study in depth the simplest of the theories.

The author is trying to contribute his point of view in order to solve a problem that affects a high number of individuals, although he is also aware that this thought-provoking theory will give rise a lot of skepticism. Common baldness is not a deadly condition, although it causes serious problems to people's self-image and self-esteem, especially to women. Opening new scientific research regarding this subject is suggested, as well as research on the sebum flow into the hair follicle and its connection with the transport of stem cells or label-retaining cells, which are extremely important to the biological mechanism of hair.

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References

- [1] Scarmeas N, Levy G, Tang MX, Manly J, Stern Y. Influence of leisure activity on the incidence of Alzheimer's disease. *Neurology* 2001;57(12):2236–42.

- [2] Stenn KS, Paus R. Controls of hair follicle cycling. *Physiol Rev* 2001;81:449–94.
- [3] Ellis JA, Stebbing M, Harrap SB. Genetic analysis of male pattern baldness and the 5 alpha-reductase genes. *J Invest Dermatol* 1998;110(6):849–53. Available from: <http://dx.doi.org/10.1046/j.1523-1747.1998.00224.x>.
- [4] Hwang S, Kim JC, Ryu HS, et al. Does the recipient site influence the hair growth characteristics in hair transplantation? *Dermatol Surg* 2002;28(9):798–9. Available from: <http://dx.doi.org/10.1046/j.1524-4725.2002.02041.x>.
- [5] Paik JH, Yoon JB, Sim WY, Kim NI. The prevalence and types of androgenetic alopecia in Korean men and women. *Br J Dermatol* 2001;145(1):95–9. Available from: <http://dx.doi.org/10.1046/j.1523-1747.1998.00224.x>.
- [6] Sabouraud R. *Maladies du cuir chevelu. I Les Maladies Séborrhéiques. Séborrhée, acn's, calvitie* Paris: Masson et Cie, 1902.
- [7] Briki F, Busson B, Kreplak L, Dumas P, Doucet J. Exploring a biological tissue from atomic to macroscopic scale using synchrotron radiation: example of hair. *Cell Mol Biol (Noisy-legrand)* 2000;46(5):1005–16.
- [8] Wix MA, Wertz PW, Downing DT. Polar lipid composition of mammalian hair. *Comp Biochem Physiol B* 1987;86(4):671–3.
- [9] Panteleyev AA, Jahoda CA, Christiano AM. Hair follicle predetermination. *J Cell Sci* 2001;114(19):3419–31.
- [10] Montine T, Neely M, Quinn J, et al. Lipid peroxidation in aging brain and Alzheimer's disease (1,2). *Free Radical Biol Med* 2002;33(5):620–6. Available from: [http://dx.doi.org/10.1016/S0891-5849\(02\)00807-9](http://dx.doi.org/10.1016/S0891-5849(02)00807-9).

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