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Androgenetic Alopecia: How It Happens

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Androgenetic alopecia (AGA) affects both genders and is characterised by hair loss in a distinctive and reproducible pattern from the scalp.[1] Local and systemic androgens transform large terminal follicles into smaller vellus-like ones.[2] Follicular miniaturization is the histological hallmark of AGA.[3,4]

Diffuse hair thinning and increased hair shedding precede the appearance of baldness by a number of years. This is because the follicular miniaturization of AGA does not simultaneously affect all follicles within a follicular unit (FU). Instead, there is a hierarchy of follicular miniaturization with a follicular unit's secondary follicles affected initially and primary follicles miniaturized last.[5]

Scalp hairs arise from FUs that are best seen on horizontal scalp biopsy. FUs comprise a primary follicle that gives rise to an arrector pili muscle (APM), a sebaceous gland, and multiple secondary follicles that arise distal to the APM (Figure 1). Hairs from secondary follicles commonly emerge from a single infundibulum (Figure 2). In contrast, hairs over the beard, trunk, and limbs do not give rise to secondary hairs and exist singly or in groups of 3, known as Meijeres trios (Figure 3). Miniaturization occurs initially in the secondary follicles, leading to the reduction in hair density that precedes visible baldness (Figure 4). Baldness ensues when all of the hairs within a FU are miniaturized.

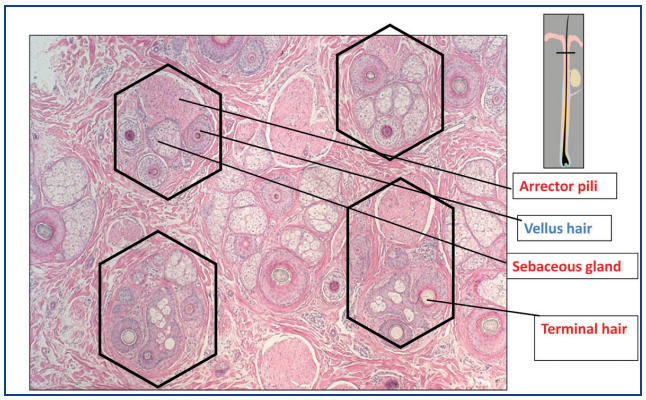

Figure 1. Horizontal section of skin biopsy from a hairy scalp showing features of early androgenetic alopecia. Follicles exist within follicular units comprising arrector pili muscle, sebaceous gland and derived secondary hairs, some of which have miniaturized to become secondary vellus hairs.

Figure 2. Multiple hair fibres can be seen to emerge from a single infundibulum.

One vexing question is that identical hair follicle miniaturization is seen histologically in lesions of alopecia areata. In this condition, miniaturization of all follicles occurs simultaneously. Unlike AGA, miniaturization in alopecia areata is potentially fully reversible.

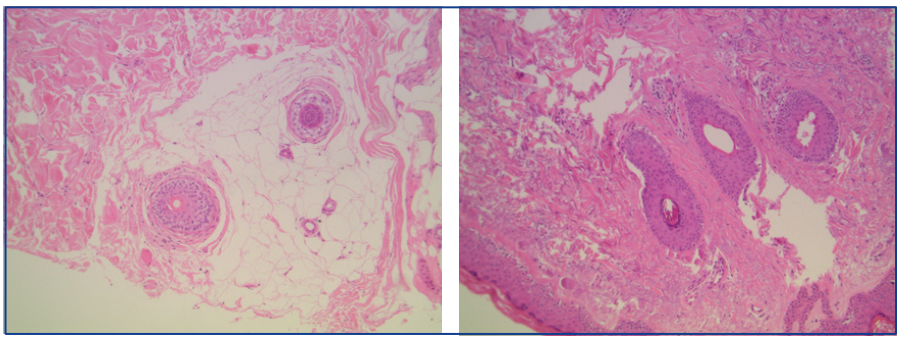

Figure 3. Horizontal section of skin biopsy from a hairy forearm showing follicles to exist singly (*left*) or in groups of 3 (*right*), known as Meijeres trios.

This apparent paradox can be explained by investigation of the arrector pili muscle (APM) and in particular its proximal attachment to the hair follicle bulge.[9] The APM is a small band of smooth muscle that runs from the hair follicle to the adjacent upper dermis and epidermis. This muscle contributes to thermoregulation and sebum secretion. The APM arises proximally at the hair follicle at the bulge, which is an epithelial stem cell niche. Three-dimensional reconstructions of scalp biopsy specimens demonstrate that preservation of the APM predicts reversible hair loss (Figure 5) and conversely

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