

# Androgenetic Alopecia in Adolescents

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*Androgenetic alopecia (AGA), or hereditary hair thinning, is a common and unwelcome cause of hair loss in men and women. AGA also occurs in adolescents, though its prevalence in this younger population is not known. Physical appearance is extremely important to most adolescents, and early onset of hair loss can have a definite negative effect on self-image and self-esteem. Minoxidil topical solution is widely used by adults for hair loss, but its use by adolescents has not been systematically evaluated. This article provides an overview of AGA and presents new information on the prevalence and age at onset of hereditary hair thinning in adolescents. In addition, data are presented on the efficacy and proper use of minoxidil topical solution in adolescent boys and girls.*

**H**air loss of any kind is a source of distress to affected individuals. This report focuses on androgenetic alopecia (AGA), or hereditary hair thinning. Approximately 50% of men have some degree of male pattern hair loss by 40 years of age. Male pattern hair loss is an expected, although often unwelcome, consequence of heredity. It is not always realized, however, that women have a similar incidence of female pattern hair loss.<sup>1</sup> Typically, AGA begins in the teenage years through the 30s. For some people, however, it starts during puberty. Expression of AGA requires the presence of normal androgen together with a genetic predisposition. Puberal changes related to normal increased andro-

gen production appear in some as early as 9 years of age and in others, in the teenage years. Youngsters with a genetic predisposition to AGA may show the first signs of scalp hair thinning during these early years.

For adolescents who experience hair thinning, the psychological effect may be considerable. Feelings of unattractiveness due to a perceived physical deficit or abnormality such as thinning hair can be a source of distress and social dysfunction for an adolescent. This can result in anxiety, depressed mood, isolation, embarrassment, and other social maladjustments.<sup>2</sup> The media perpetuate this emphasis on physical appearance by portraying stereotypical images of male and female youngsters and adults with full heads of hair.

This article reviews the pathophysiology of AGA and presents new data on the prevalence and age at onset of AGA in adolescents. The use of minoxidil topical solution for the treatment of AGA in adolescent boys and girls also is presented.

## Psychological Effects of Hair Loss

Apprehension about physical appearance, including thinning hair, can be distressing to adolescents and young adults and may contribute to poor self-esteem and impaired functioning at home, at school, at work, and in social relationships. Studies in adults have shown that hair loss in men is associated with distress, preoccupation, and marked coping efforts. These effects are particularly apparent in younger men and those with extensive or early-onset hair loss.<sup>3</sup> In women with AGA, negative psychological sequelae are even more severe and disabling than they are in men.<sup>4,5</sup> Women with AGA report lower self-esteem, psychosocial well-being, and satisfaction with life and greater social anxiety and self-consciousness compared with men.<sup>4</sup> Satisfaction with appearance is also very important to adolescents.<sup>2,6</sup> In a study of 16-year-old girls, all 67 participants expressed their great desire to be thin and

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**Figure 1.** Androgenetic alopecia in an 18-year-old man showing early thinning of frontal scalp and vertex region and accentuation of bitemporal recession.



**Figure 2.** Androgenetic alopecia in an 18-year-old woman with diffuse thinning over the frontal scalp. The frontal hairline is characteristically retained in women with androgenetic alopecia.

physically attractive.<sup>7</sup> These girls revealed that their desire to lose weight stemmed from the influence of the media, their peers, and their desire to be more attractive, gain more attention, and be more confident. Similar influences of the media and peer groups make the presence of thinning hair a source of great distress and insecurity in adolescents.

### Physiology of Hair Growth

An understanding of the physiology of hair growth is essential to the understanding of hair loss. Hair growth occurs in a 3-phase cycle: anagen growth phase, catagen transitional phase, and telogen resting phase.<sup>8,9</sup> The duration of the anagen growth phase of scalp hair varies between 2 and 6 years. Individuals with a longer anagen growth phase are able to grow longer hair. Approximately 90% to 95% of scalp hairs are normally in anagen growth phase. Catagen transitional phase is characterized by regression of the lower transient half of the hair follicle. Less than 1% of scalp hairs are in catagen transitional phase, which lasts about 3 weeks. Approximately 5% to 10% of scalp hairs are in telogen resting phase, which lasts about 3 months, after which these hairs are shed.<sup>9,10</sup> Normally, between 40 and 100 hairs are shed daily on a non-shampoo day; twice as many are shed on days when the hair is shampooed. Shed hair is replaced by new hair that grows from the same follicle.

*Pathophysiology of AGA*—AGA results from the influence of normal androgen on genetically susceptible hair follicles.<sup>11-13</sup> Dihydrotestosterone, the  $5\alpha$ -reductase metabolite of testosterone, activates the genes responsible for both shortening the hair growth cycle and for gradually transforming large hair follicles to smaller and smaller follicles. There is no loss of hair follicles in AGA; rather, the follicles become miniaturized and produce shorter and finer hair that does not cover the scalp as well.<sup>9,14-16</sup>

### Clinical Diagnosis of AGA in Adolescents

The clinical expression of AGA in adolescents is milder than in adults (Figures 1 and 2). Inheritance patterns of AGA are polygenic. Hence, a family history of AGA on either or both sides of the family is often present, but is not essential for the diagnosis. In boys, AGA is recognized by changes in 3 scalp regions: frontal scalp, vertex region, and bitemporal region. The frontal and vertex regions may show mild, decreased hair density and miniaturized, shorter, finer hair. In addition, there may be accentuation of the bitemporal recession. These early changes may be observed in any or all of the 3 scalp regions.

AGA may be less easily recognized in adolescent girls than in boys. The astute clinician must listen to the concerned patient and her parents when they

Table 1.

**Prevalence of Androgenetic Alopecia in Adolescent Boys Aged 15 to 17 Years**

	15 y (n=172)	16 y (n=157)	17 y (n=167)	All Patients (N=496)
≥Stage 2 hair loss,* n (%)	16 (9.3)	29 (18.5)	32 (19.2)	77 (15.5)
Early signs of androgenetic alopecia as assessed by investigators, n (%)	16 (9.3)	26 (16.6)	28 (16.8)	70 (14.1)

\*Assessed using a modified Hamilton-Norwood grading scale. Stage 2 indicates the normal postpuberal reshaping of the frontal hairline. Greater than stage 2 indicates early frontal hair thinning and early vertex region thinning, with or without accentuated bitemporal recession.

Adapted with permission from Trancik et al.<sup>18</sup>

describe the overall decrease in hair density compared with its previous state, even though the scalp may still appear adequately covered. Early diffuse hair thinning in girls usually is most evident over the frontal scalp, with increased spacing between hairs and a widened appearance of the central part. Also, the size of the ponytail is decreased. Often the distal ends of the hair are skimpy, and the hair does not grow as long as it previously grew.<sup>17</sup>

Other clinical signs of puberty often accompany the onset of AGA in adolescents and are reassuring. However, a careful clinical assessment is needed to confirm the absence of androgen excess. If indicated, laboratory evaluation may include measurement of total testosterone, dehydroepiandrosterone sulfate, prolactin, and thyrotropin.

### **Prevalence and Age at Onset of AGA in Adolescents**

AGA in adolescents is not uncommon and needs to be recognized by all clinicians, not only by those with a special interest in hair disorders. The following 2 studies have documented the prevalence and early age at onset of AGA.

The first study was a multicenter study to assess the prevalence of AGA in randomly selected, healthy boys.<sup>18</sup> Ten dermatologists from across the United States examined the scalps of 496 boys aged 15 through 17 years and rated the boys' hair loss using a modified version of the Hamilton-Norwood grading scale, which is a recognized rating scale for male pattern hair loss.<sup>19</sup> Stage 1 on the Hamilton-Norwood grading scale indicates a prepuberal straight hairline and a full head of hair. Stage 2

indicates the normal postpuberal reshaping of the frontal hairline. Hair loss rated greater than stage 2 indicates early frontal scalp thinning and early vertex region thinning, with or without accentuated bitemporal recession. Of the 496 boys, 77 (15.5%) were rated as having stage 2 or greater hair loss on the Hamilton-Norwood grading scale. In addition, the dermatologists were asked to assess global hair status and categorize each boy as either exhibiting early signs of AGA or showing no evidence of AGA. Seventy boys (14.1%) showed early signs of AGA (Table 1).

The second study surveyed 84 clinicians who provided data on 448 adolescents with AGA. This group included 341 boys and 107 girls who sought treatment for their thinning hair.<sup>20</sup> Hair loss in this population began between ages 7 and 17 years, with a mean age at onset of 14.8 years in boys and 13.8 years in girls (Table 2). A family history of AGA was present either on the father's side or the mother's side, or on both sides, in keeping with the polygenic inheritance pattern of AGA.

### **Minoxidil Topical Solution in the Treatment of Adolescents With AGA**

The mechanism by which minoxidil stimulates hair growth is not completely understood. The drug is a potassium channel opener and potent vasodilator, although this latter property does not appear to be essential for its hair growth-promoting effect.<sup>21-23</sup> Topical minoxidil increases the duration of the anagen growth phase; however, it has this effect only on suboptimal hair follicles (ie, hairs not expressing their full growth potential).<sup>24</sup> The net

Table 2.

**Demographic Characteristics of Adolescents With AGA\***

	Boys (n=341)	Girls (n=107)	All Patients (N=448)
Mean age at onset of hair thinning, y (range)	14.8 (7–17)	13.8 (8–17)	14.6 (7–17)
Sites of hair thinning, n (%)			
Frontal region	131 (38.4)	49 (45.8)	180 (40.2)
Vertex region	72 (21.1)	16 (15.0)	88 (19.6)
Both frontal and vertex regions	137 (40.2)	37 (34.6)	174 (38.8)
Family history of AGA, n (%)			
In male family members	248 (72.7)	61 (57.0)	309 (69.0)
In female family members	128 (37.5)	61 (57.0)	189 (42.2)

\*AGA indicates androgenetic alopecia.

Adapted with permission from Trancik et al.<sup>20</sup>

effect of minoxidil is that fine, shorter, miniaturized hairs become longer, thicker, and more pigmented.<sup>9</sup>

**Bioavailability of Minoxidil Topical Solution in Adolescents**—The pharmacokinetic profile and safety of minoxidil topical solution in adolescents were studied in a single-arm, open-label investigation of 13 boys, aged 13 to 17 years (mean age, 15.9 years), with early signs of AGA.<sup>25</sup> The participants applied 1 mL of minoxidil topical solution 5% to the area of thinning hair every morning and evening for one week. Blood and urine samples were assayed for unchanged minoxidil and total minoxidil (the sum of unchanged minoxidil and minoxidil glucuronide). Steady-state concentrations were achieved rapidly following application of minoxidil topical solution 5%. The mean peak steady-state concentration was 1.58 ng/mL, well below the 20 ng/mL threshold level at which minor changes in pulse rate are first noted. In fact, minoxidil topical solution did not alter pulse rate, blood pressure, or other vital signs. The percutaneous absorption of minoxidil topical solution 5% in this study of adolescent boys is similar to that observed in adults.<sup>26,27</sup> Although there is a high degree of intersubject variability, the mean serum concentration in adults is 2.6 ng/mL, which is comparable with serum concentrations in adolescents.

**Efficacy of Minoxidil Topical Solution in Adolescents**—Several studies<sup>25,28-30</sup> (also R. J. Trancik, MD, and

J. Rundegren, MD, unpublished data, 2002) of men and women have demonstrated that minoxidil topical solution applied twice daily is an effective treatment for AGA in adults; it significantly increases hair count, hair weight, and clinically visible hair, which improves scalp coverage. In 1988, minoxidil topical solution 2% was approved by the US Food and Drug Administration for the treatment of AGA in men aged 18 to 50 years, and in 1991 the drug was approved for women aged 18 to 45 years. In 1997, the 5% solution was approved by the US Food and Drug Administration as an over-the-counter treatment for men with AGA.

Data on the use of minoxidil topical solution in adolescents with AGA was assessed retrospectively in the survey of 84 clinicians described earlier in this report (Table 2).<sup>20</sup> Mean age at treatment initiation in this population of 448 boys and girls was 15.6 years (Table 3). At the time of the survey, minoxidil topical solution had been used for approximately 18 months. Overall, of the 373 patients whose response to treatment was known, 95% responded to treatment; more than 50% had improvement in scalp coverage, and more than 40% had slowing of further hair thinning. Approximately 5% of the 373 patients did not respond to minoxidil therapy. Minoxidil topical solution was well tolerated, with adverse reactions consisting

Table 3.

**Treatment With Minoxidil Topical Solution for Androgenetic Alopecia**

	Boys (n=341)	Girls (n=107)	All Patients (N=448)
Mean age at treatment initiation, y (range)	15.8 (10–17)	15.2 (10–17)	15.6 (10–17)
Patients whose response to treatment was known, n (%)	286 (76.7)	87 (23.3)	373 (83.3)
Favorable response,* n (%)	272 (95.1)	82 (94.3)	354 (94.9)
Improved scalp coverage	157 (54.9)	44 (50.6)	201 (53.9)
Slowing of further hair thinning	115 (40.2)	38 (43.7)	153 (41.0)
No response, n (%)	14 (4.9)	5 (5.7)	19 (5.1)

\*Defined as improved scalp coverage or slowing of further hair thinning.

Adapted with permission from Trancik et al.<sup>20</sup>

primarily of itching and mild scalp irritation. Based on these findings, minoxidil topical solution appears to be an effective and well-tolerated treatment for adolescents with AGA.

**Retardation of Further Hair Loss**—Clinical studies of minoxidil have focused primarily on hair regrowth in adults, but the retardation of further hair loss is also important, especially in adolescents. Data from a hair weight clinical trial show that minoxidil slowed the progression of hair loss and increased hair growth (Figure 3).<sup>29</sup> The study included 4 treatment groups (minoxidil topical solution 5% and 2%, placebo solution, and untreated controls). During the 96 weeks of treatment, the minoxidil topical solution 5% and 2% groups showed approximately a 30% hair weight increase. In contrast, the placebo and untreated groups were much alike in their response and showed about a 6% per year decrease in hair weight from baseline ( $P \leq .005$ ). Thus, during the 96-week treatment period, minoxidil slowed the progressive loss of hair weight that occurred in the placebo and untreated groups. After minoxidil treatment was stopped at week 96, the minoxidil topical solution 5% and 2% groups showed a rapid loss of hair weight, and 24 weeks after stopping treatment, hair weight was similar in all 4 groups. This rapid loss of hair weight after stopping minoxidil demonstrates that minoxidil retards the progression of hair loss that would occur without treatment. The slowing of further hair

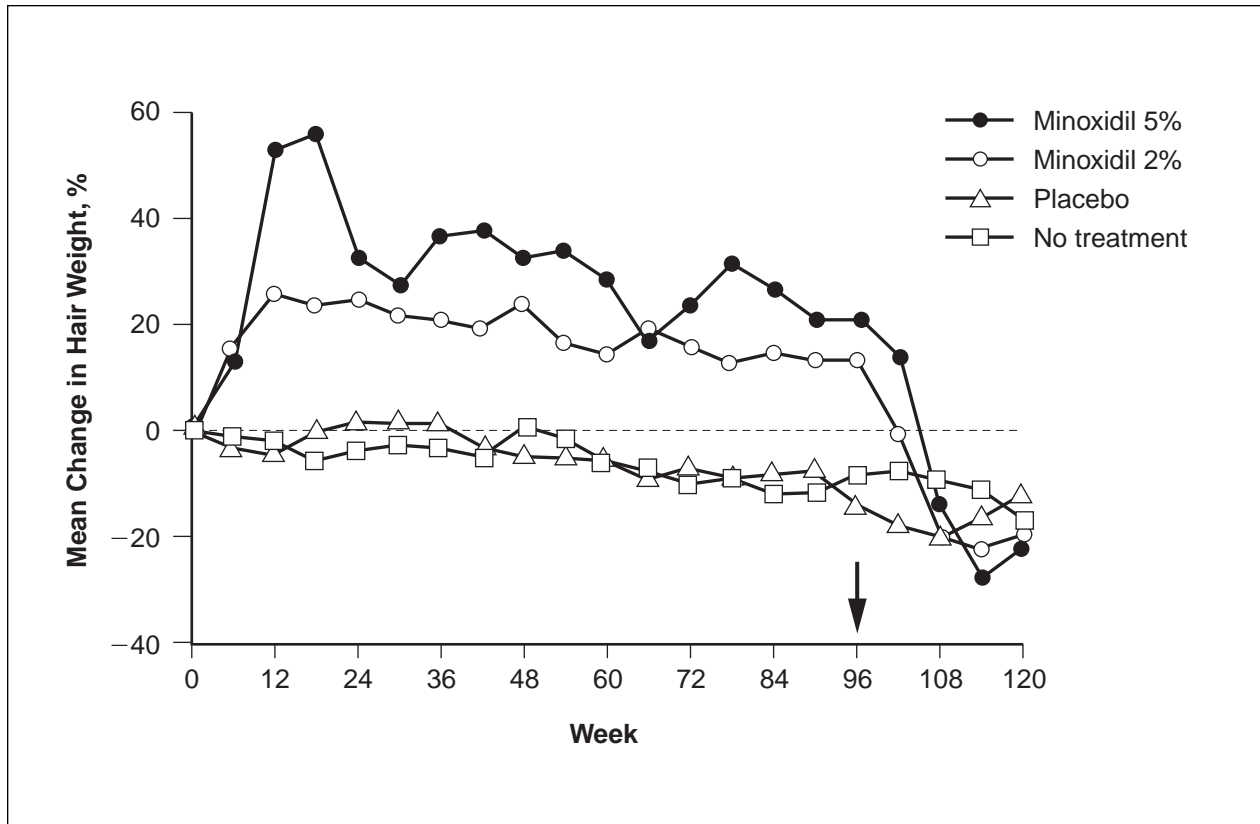
loss is particularly important in adolescents because those with early onset of AGA usually have the most extensive thinning in adulthood.

### **Finasteride in the Treatment of Adolescents With AGA**

Finasteride is a  $5\alpha$ -reductase inhibitor that also is approved for treatment of AGA in men 18 years and older. However, there are no data on the use of finasteride in adolescent boys. Finasteride is contraindicated in women who are or may become pregnant because the drug has the potential to cause genital defects in the male fetus.<sup>9</sup>

### **Guidelines for Use of Minoxidil Topical Solution**

Clinical experience and the findings of controlled clinical studies show that successful treatment with minoxidil topical solution requires proper use of the formulation. Minoxidil topical solution must be applied twice daily as directed for clinical results. The solution must be applied directly to the dry scalp using the dropper applicator, which delivers the 1-mL dose. Hair can be shampooed as usual. However, if hair is shampooed before minoxidil is applied, the scalp must be completely dry before applying the solution. If hair is to be shampooed after applying minoxidil, the patient must wait one hour before shampooing. Hair dryers should not be used to facilitate drying of the solution. Optimal



**Figure 3.** Comparison of mean percentage change in interval weight of hair per square centimeter in men with androgenetic alopecia who received 1 of 4 treatments for 96 weeks: minoxidil topical solution 5%, minoxidil topical solution 2%, placebo solution, or no treatment. Arrow indicates cessation of treatment.

results and patient satisfaction are best achieved with proper use of the formulation and with realistic expectations. After one year, treatment must be continued twice daily to maintain the benefit.

**Conclusion**

AGA is an unwelcome event in the lives of genetically susceptible adolescents and can be associated with great distress and impairment in functioning. Adolescent-onset AGA is not uncommon and needs to be recognized by clinicians treating this age group. Approximately 15% of adolescents have early-onset AGA, which on average appears at 14 years of age in girls and 15 years of age in boys, although it can appear as early as 7 years of age.<sup>18</sup> When used according to directions (1 mL applied directly to dry scalp twice daily), minoxidil topical solution appears to have utility and be well-tolerated in adolescent boys and girls with AGA. Moreover, minoxidil effectively slows the progression of hair thinning, which is also important.<sup>29</sup> Finasteride has not been studied in the treatment of men younger than 18 years, and thus the safety

and efficacy of this drug in the treatment of early-onset adolescent AGA has not been determined.

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