A RANDOMISED CONTROLLED SINGLE OBSERVER BLINDED STUDY TO DETERMINE THE EFFICACY OF TOPICAL MINOXIDIL PLUS MICRONEEDLING VERSUS TOPICAL MINOXIDIL IN THE TREATMENT OF ANDROGENETIC ALOPECIA"

Submitted by

DR. KOWSHIK KUMAR M

Dissertation submitted to the

BLDE UNIVERSITY. VIJAYAPUR, KARNATAKA

In the partial fulfillment of the requirements for the degree of

M.D.

In

DERMATOLOGY, VENEREOLOGY AND LEPROSY

UNDER THE GUIDANCE OF

DR. ARUN C. INAMADAR **M.D, D.V.D, F.R.C.P**

PROFESSOR & HEAD

DEPARTMENT OF DERMATOLOGY, VENEREOLOGY AND LEPROSY.

B.L.D.E. UNIVERSITY'S

SHRI. B. M. PATIL MEDICAL COLLEGE HOSPITAL &

RESEARCH CENTRE, VIJAYAPUR

2017

B. L. D. E. UNIVERSITY's

SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL &

RESEARCH CENTRE, VIJAYAPUR.

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"A RANDOMISED CONTROLLED SINGLE OBSERVER BLINDED STUDY TO DETERMINE THE EFFICACY OF TOPICAL MINOXIDIL PLUS MICRONEEDLING VERSUS TOPICAL MINOXIDIL IN THE TREATMENT OF ANDROGENETIC ALOPECIA "** is a bonafide and genuine research work carried out by me under the guidance of **DR. ARUN C. INAMADAR.**, Professor and HOD, Department of Dermatology, Venereology and Leprosy at BLDE University's Shri B. M. Patil Medical College Hospital and Research Centre, Vijayapur.

Date: **Dr. KOWSHIK KUMAR M**

Place: Vijayapur

B. L. D. E. UNIVERSITY's

SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL &

RESEARCH CENTRE, VIJAYAPUR.

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled **"A RANDOMISED CONTROLLED SINGLE OBSERVER BLINDED STUDY TO DETERMINE THE EFFICACY OF TOPICAL MINOXIDIL PLUS MICRONEEDLING VERSUS TOPICAL MINOXIDIL IN THE TREATMENT OF ANDROGENETIC ALOPECIA"**is a bonafide research work done by **Dr. KOWSHIK KUMAR M** in partial fulfillment of the requirement for the degree of M.D in Dermatology, Venereology and Leprosy.

Date:
Place: Vijayapur

DR. ARUN C. INAMADAR
Professor and HOD,
Department of Dermatology,
Venereology and Leprosy
B.L.D.E.U's Shri. B. M. Patil
Medical College Hospital &
Research Centre, Vijayapur.

B. L. D. E. UNIVERSITY's

SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL &

RESEARCH CENTRE, VIJAYAPUR.

ENDORSEMENT BY THE HOD AND PRINCIPAL

This is to certify that the dissertation entitled **"A RANDOMISED CONTROLLED SINGLE OBSERVER BLINDED STUDY TO DETERMINE THE EFFICACY OF TOPICAL MINOXIDIL PLUS MICRONEEDLING VERSUS TOPICAL MINOXIDIL IN THE TREATMENT OF ANDROGENETIC ALOPECIA "**is a bonafide research work done by **Dr. KOWSHIK KUMAR M** under the guidance of **DR. ARUN C. INAMADAR**, Professor and HOD, Department of Dermatology, Venereology and Leprosy at BLDE University's Shri. B.M. Patil Medical College Hospital and Research Centre, Vijayapur.

Dr. Arun C. Inamadar M.D.,D.V.D, FRCP
Professor & Head
Department Of Dermatology, Venereology & Leprosy
B.L.D.E.U's Shri. B.M. Patil Medical College Hospital & Research Centre, Vijayapur.

Date:
Place: Vijayapur

DR. S.P. Guggarigoudar MS.
Principal,
B.L.D.E.U's Shri. B. M. Patil Medical College Hospital & Research Centre, Vijayapur.

Date:
Place: Vijayapur

B. L. D. E. UNIVERSITY's

SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL &

RESEARCH CENTRE, VIJAYAPUR.

COPYRIGHT

Declaration by the candidate

I hereby declare that the BLDE University, Karnataka shall have the rights to preserve, use and disseminate this dissertation / thesis in print or electronic format for academic/ research purpose.

Date: **Dr. KOWSHIK KUMAR M**

Place: Vijayapur

ACKNOWLEDGEMENT

With proud privilege and deep sense of respect I express my gratitude and indebtedness to my guide and esteemed teacher **Dr. Arun. C. Inamadar** M.D, D.V.D, F.R.C.P., Professor and Head, Department of Dermatology, Venereology and Leprosy, BLDE UNIVERSITY's Shri B. M. Patil medical college for his continuous supervision, valuable suggestions, able guidance and unparalleled encouragement throughout the course of this study.

I am extremely grateful to **Dr. Aparna Palit** MD., Professor, Department of Dermatology, Venereology and Leprosy for her everlasting inspiration, constant encouragement and constructive criticism throughout my post-graduate programme.

I would like to thank **DR. S.P. Guggarigoudar** MS., Principal of BLDE UNIVERSITY's Shri B. M. Patil medical college, Bijapur, for permitting me to utilize hospital resources for completion of my work.

I wish to express gratitude and respect to my teachers **Dr. Keshavmurthy Adya**, Asst Prof, **Dr. Ajit Janagond** Asst Prof, and **Dr. N. S. Deshmukh**, senior resident for their valuable help and guidance during my study.

I take this opportunity to thank my greatest assets, my parents **Mr. Venu Gopal M** and **Mrs Gayathri Devi M** who are the pillars of my strength and achievement. My beloved brother **Nikhil Kumar M** and sister-in-law **Sree Lalitha** for their constant support and encouragement.

I share the credit of my work with my friends and colleagues, **Dr Anusha. S**, **Dr Naresh kumar** for their companionship and support.

I would like to thank my seniors **Dr Ajay Mujja, Dr Sneha Manjunath, Dr Joe Thomas**, **Dr Bhagyashree. K** and **D**r **Neha Khurana**, and my juniors **Dr Ashwini**, **Dr Deepa** and **Dr Sushuruth, Dr Nazneen, Dr Rintu, Dr Navya** for their cooperation and help.

I express my thanks to the **Mrs Shamshad**, **Mr Dalawai** and all other hospital staff for their kind co-operation during my study.

I would like to express my thanks to **Mrs. Vijaya Soragavi**, statistician, Department of Community Medicine, for his help in statistical analysis.

My special thanks to **Mr. Babu Patil** "Om Sai Internet", Vijayapur for computerizing my dissertation work in a right format.

This dissertation would not have been possible without the co-operation and understanding of the patients involved in this study.

Finally, I thank the **almighty** for all the blessings

Date: **DR KOWSHIK KUMAR**

Place: Vijayapur

LIST OF ABBREVIATIONS

1. AGA : Androgenetic alopecia
2. DP : Dermal papilla
3. DHT : Dihydrotestosterone
4. DPC's : Dermal papilla cells
5. SNP : Single nucleotide polymorphisms
6. AR: Androgen receptor
7. IGF : Insulin like growth factor
8. bFGF: Basic fibroblast factor
9. VEGF : Vascular endothelial growth factor
10. TGF-β1 : transforming growth factor beta 1
11. IL-1α : Interleukin 1 alpha
12. TNF-α : Tumor necrosis factor alpha
13. DKK-1 : dicckopf 1
14. HSD : hydroxysteroid dehydrogenase
15. GSK-3β : Glycogen synthase kinase
16. FT : frontotemporal
17. BA : Basic
18. SP : Specific
19. HDD : Hair diameter diversity
20. HGF : Hepatocyte growth factor
21. NLC : Nanostructure lipid carriers
22. NE : Nanoemulsions
23. KGF : Keratinocyte growth factor

24. PRGF : Plasma rich in growth factors
25. FUE : Follicular unit extraction
26. HSC : Hair stimulating complex
27. GP4G : Diguanosine tetraphosphate
28. PDGF : Platelet derived growth factor

ABSTRACT

Background: Androgenetic alopecia is a genetically predisposed androgen induced pattern of progressive hair loss. Dermal papilla (DP) is the site of expression of various hair growth related genes. According to various studies Wnt proteins and wound growth factors help in stimulating DP associated stem cells. Microneedling works by stimulation of stem cells and inducing activation of growth factors. Minoxidil causes increased expression of VEGF mRNA and activates β-catenin activity in the DP cells.

Objectives: Objective of this study was to study the effect of microneedling technique along with topical minoxidil versus minoxidil in male androgenetic alopecia.

Materials and method: Sixty eight men with grade III and IV androgenetic alopecia (AGA) were recruited into 2 groups. After randomization one group was offered weekly microneedling treatment with twice daily 5% minoxidil lotion (study group); other group was given only 5% minoxidil lotion (control group). Baseline global photographs were taken. Dermoscopic images were taken from a 1 cm targeted fixed area at baseline and at end of therapy (week 12) from where hair count was done. The 2 primary efficacy parameters assessed were: Increase from baseline hair count at 12 weeks and patient self assessment of hair growth at 12 weeks. Two blinded investigators evaluated response on computer screen using dermoscopic images. Patient's self perception regarding hair growth was assessed by 10 inch long visual analogue scale.

Results: (1) Hair counts – The mean increase in hair count at week 12 was significantly greater for the study group compared to the control group (12.52 vs 1.89 respectively). (2) Patient evaluation – In the study group, 4 (12.9%) patients reported 50% improvement versus none in the control group.

Conclusion: Dermaroller along with Minoxidil treated group was superior to minoxidil treated group in promoting hair growth in men with AGA for 2 primary efficacy parameters of hair growth, the response achieved is not cosmetically significant. However, the total number and frequency of sessions and long-term sustainability of response of microneedling need to be evaluated within a larger population. Microneedling in combination with minoxidil is a safe and a promising therapy to treat hair loss refractory to minoxidil monotherapy.

Key Word : AGA, Androgenetic alopecia, Microneedling.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Healthy hair is important for the youthful and attractive appearance of individuals and it also relates to socialisation. In our youth-oriented and glamour-obsessed modern society, not only women but even men are very conscious about their physical appearance[1]. Thus the consequences of androgenetic alopecia (AGA) are predominantly psychological. Alopecia induced by androgens, in genetically predisposed individuals, is termed as AGA.[1]

AGA is the most frequent form of hair loss encountered in clinical practice. The lack of balding in eunuchs, pseudohermaphrodites and individuals with androgen insensitivity syndrome confirms that androgens are a prerequisite for common baldness. The efficacy of conventional therapy (minoxidil and finasteride) in AGA that is based on both preventing hair loss and promoting hair re- growth, varies between 30% and 60%. Unfortunately about 40% of men with AGA remain or go bald despite being on conventional therapy. This has led to a large number of patients remaining unsatisfied with respect to new hair growth with the current therapies, who needs better cosmetic coverage over the scalp.[2]

Topical Minoxidil and oral Finasteride are the only two currently approved drugs by Food and Drug Administration [USA] for treatment of AGA in men.[3,4] Topical Minoxidil 5% solution, 1ml applied twice daily is effective in preventing progression and improving AGA in males.[5]

The dermal papilla (DP) is a cluster of specialized fibroblasts that regulate the growth and activity of the various cells in the follicle, thereby, it plays an important role in the regulation of hair cycle and growth. Regeneration of hair follicle starts

when signals from the mesenchyme derived DP cells reach multipotent epidermal stem cells in the bulge region.[3]

Circulating androgen dihydrotestosterone (DHT), enter the follicle via the DP's capillaries, then bind to the androgen receptor on the DP cells and further activate or repress molecular signalling pathways which are responsible for premature transition from anagen to catagen and follicular miniaturization.[3] The pathogenesis of AGA involves not only DHT but also inflammation, many genes, signalling pathways (stimulatory pathways like Wnt/B catenin, stat 3 and Shh and inhibitory pathways of Dkk-1, BMP 4 and Dickkopf-related protein 1), growth factors, activation of stem cells of the hair bulge and improving vascularity. The existing conventional therapies (i.e. finasteride and minoxidil) fail to target all of the above mechanisms as they mainly target the androgens.[2]

Microneedling is a recent modality of treatment for AGA that acts by stimulation of stem cells and inducing activation of growth factors which stimulate DP.[2,3] It is done using an instrument called dermaroller.

Recently, microneedling induced hair growth in mice has been reported. Study done by Dhurat *et al.*[3] in humans has shown that microneedling is a safe, effective and also a promising tool in hair growth stimulation when used along with minoxidil in male and female androgenetic alopecia. Microneedling augments the hair growth induced by minoxidil. Hence, this study is undertaken to compare the efficacy of minoxidil alone and minoxidil combined with microneedling in male androgenetic alopecia.

OBJECTIVE OF THE STUDY

To study the efficacy of combination of topical minoxidil and microneedling versus minoxidil alone in male AGA.

REVIEW OF LITERATURE

Male androgenetic alopecia (AGA , Male pattern baldness) is the most common cause of hair loss over scalp in men. The term androgenetic alopecia was first proposed and introduced by Orentreich.[1]

Psychological effects of AGA:

Psychosocially, men with AGA have the tendency to have low self-esteem, distant peer relationships and might even suffer from depression as it affects their cosmetic consciousness and self image.[1]

Epidemiology:

AGA in men is considered to be the most common type of baldness of scalp characterized by progressive hair loss.[5] According to Hamilton, about 30-50% of men develop AGA by the age of 50.[4] AGA can affect all races, but with variable prevalence rates. Caucasians were found to have highest prevalence. It is estimated that prevalence rates in Caucasian populations is around 30% for men in their 30s, 40% in their 40s and 50% in their 50s.[5] In the Indian context, a study done on clinical pattern of AGA in 150 subjects showed a peak incidence of 48% in males aged 15-24years.[1]

Etiopathogenesis of AGA in Men:

Hair is lost and replaced cyclically. Hair follicles undergo corresponding cyclic phases of growth, involution, quiescence and regeneration known as hair cycle [figure 1]. The active growth phase (anagen) lasts for 3-5 years. At the end of anagen, there is a brief stage of regression known as catagen which lasts for few weeks. This is followed by a period of hair follicle quiescence and lasts

approximately 3 months known as telogen. The catagen phase is a process of involution, where a burst of apoptosis occurs in a majority of follicular keratinocytes along with termination of pigment production and condensation of dermal papillae. This results in an upward movement of dermal papillae. In the telogen phase the shaft of hair matures into a club (vellus) hair. Eventually the hair sheds as a result of combing and washing and the anagen phase begins again.[5,6]

In AGA , there is a gradual decrease in duration of anagen with each cycle, while the length of telogen phase remains constant or is prolonged. This results in a reduction of the anagen to telogen ratio. As the duration of anagen phase determines the length of the hair, the maximum length of the new anagen hair becomes shorter than that of its predecessor. The result is a progressive and gradual miniaturisation of the entire follicular apparatus in Male pattern baldness.[5,6]

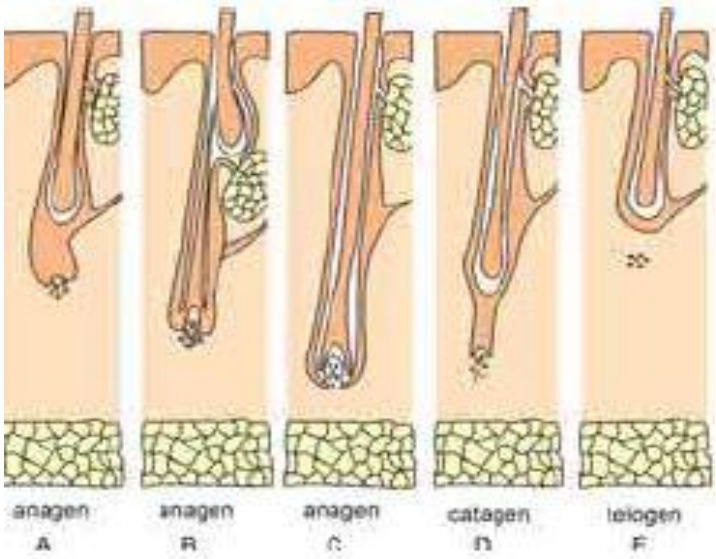


Figure 1: Hair cycle

A) Genetics [5]:

A polygenic mode of inheritance has been established due to the high prevalence and the wide range of expressed phenotypes in AGA. The genes influence their predisposition through DNA sequence variations like single nucleotide polymorphisms (SNP), microsatellite repeats, insertion mutations, deletion mutations and copy number variations; or epigenetic modifications such as X chromosome inactivation, hypermethylation (switch off gene expression) or hypomethylation (switch on gene expression) in gene promoter regions of DNA.

The two major loci of genetic risk for AGA are the X chromosome AR/EDA2R locus and the PAX1/FOX A2 locus on chromosome 20. Recent studies have identified a new susceptibility locus, HAD C9 on chromosome 7.

The androgen receptor (AR) determines the sensitivity of cells to androgen. The AR gene regulates the potency of androgen available to the hair follicle. There are many known AR gene polymorphisms. Among them the *Stu 1 gene polymorphism* has the most significant association with AGA.

Several other genes (5α reductase, aromatase, estrogen receptor α and IGF-2 genes) have been identified where associations could not be proved conclusively.

B) Systemic hormonal effects- androgens:

Dermal papilla plays a key role in the maintenance and control of hair growth, as it is likely to be the target of androgen- mediated events leading to miniaturization and hair cycle changes.[4] Testosterone and other weaker androgens such as dehydroepiandrosterone and androstenedione are metabolized in many skin tissues. Testosterone penetrate the cell membrane freely and is converted to DHT by 5 α reductase (mainly Type II) in the cytoplasm. DHT binds

to androgen receptor (AR) and this complex is translocated to the nucleus. This results in target gene transcription and finally translation into genes which exerts biological activity.[5,7]

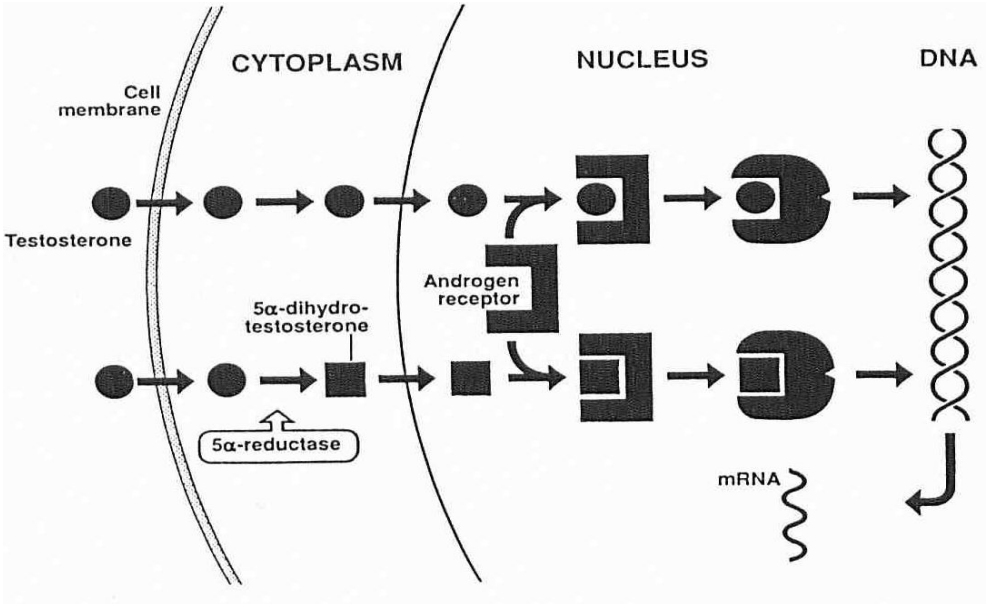


Figure 2 :Mechanism of action of androgens in dermal papilla

The dermal papillae under the influence of androgens secretes many factors, which unfolds the interaction between dermal papillae and the hair follicle cells. These factors released from dermal papillae have an autocrine effect on the dermal papillae itself and paracrine effect on the hair follicle epithelial cells. These factors include growth factors like insulin like growth factor (IGF-1), basic fibroblast factor (bFGF), vascular endothelial growth factor (VEGF); and cytokines like transforming growth factor beta 1 (TGF-β1), interleukin 1 alpha (IL -1α) and tumor necrosis factor alpha (TNF- α).[5]

The signaling process which occurs at the interface of dermal papillae and hair follicle cells in a balding person results in premature termination of anagen and associated premature entry into catagen phase. Catagen occurs as a consequence of decreased expression of anagen maintaining factors, such as the growth factors- IGF-1, bFGF and VEGF. Also, apoptosis is promoted by increased expression of cytokines (TGF-β 1, IL -1α and TNF-α) .[5] Recently, dicckopf 1 (DKK-1) gene was found to be one of the most upregulated genes by DHT, resulting in inhibition of outer root sheath cells and triggering apoptosis.[8]

C) Local hormonal effects:

In a balding scalp, the concentration of important factors such as, DHT along with 5 α reductase and AR's are increased. The other enzymes which show an increased activity in AGA are 3β hydroxysteroid dehydrogenase (3β-HSD) and 17β hydroxysteroid dehydrogenase (17β-HSD) which are involved in conversion of weak androgens to potent androgens. The higher the concentration of androgen and androgen receptor, more the effect on expression of genes which control follicular cycling.[5]

Another recent update is identification of the key role of Wnt/β catenin signalling pathway in the maintenance of the dermal papillary cell inductive properties required for hair follicle regeneration and hair shaft growth. The androgens and ligand activated AR can hamper the Wnt/β catenin signalling pathway by increasing the glycogen synthase kinase (GSK-3β) expression.[5,9]

Clinical features and grading:

This genetically determined disorder is a progressive condition. Gradual conversion of terminal hairs occurs in a highly reproducible pattern, denudes the scalp and leads to baldness. Patients have a reduction in the terminal-to- vellus hair ratio.

Patients with AGA show hair loss in a typical distribution. Preferentially three areas of the scalp are affected : the temples, vertex scalp and mid frontal scalp. The process is strictly patterned within these areas. Hair loss over the bitemporal areas starts at the anterior hair line and moves posteriorly over the scalp. Hair loss over the vertex scalp begins centrally and radiates outwards circumferentially.[4]

Numerous classification systems have been proposed to grade the male patterned baldness. Currently, the most commonly used one is Norwood-Hamilton classification. It depicts the progression of baldness from class 1 to 7 as follows [figure 3].

Norwood-Hamilton classification[1, 10]:

Type	Clinical definition
I	Minimal recession of the hairline along the anterior border in the frontotemporal (FT) region
II	The anterior border of the hair in the FT region has triangular areas of recession that tend to be symmetrical. These areas extend no further posterior than approximately 2 cm anterior to a line drawn in a coronal plane between the external auditory

	meatus on both sides. Hair is either lost or sparse along the mid-frontal border of the scalp.
III	Characterized by deep FT hair recession, usually symmetrical and either bald or sparsely covered with hair. These areas of hair recession further extend posterior than a point that lies approximately 2 cm anterior to a line drawn in a coronal plane between the external auditory meatus on either side.
IIIv (vertex)	Hair is mainly lost in the vertex. There may be some frontal recession but it does not exceed than that seen in type III.
IV	The frontal and FT recession is more severe than type III. There is also sparseness or absence of hair in the vertex area. These bald areas are extensive, but separated from each other by a band of moderately dense hair that joins the fully haired fringe on each side of the head
V	The hair loss over the vertex and FT areas is larger than in type IV and the band of hair between them is narrower and sparser
VI	The hair loss over the FT and vertex regions is confluent and the bridge of hair that crosses the crown is absent
VII	There is only a narrow horseshoe-shaped band of hair that begins laterally just anterior to the ear and extends posteriorly on the sides and fairly low on the occiput.

Type variants ‘a’ Constitutes 3% of all cases of male AGA: (i) the entire anterior border of the hairline progresses posteriorly without the normal island of hair in the mid-frontal region and (ii) there is no simultaneous development of a bald area on the vertex. Instead, the anterior recession just advances posterior to the vertex.

IIa The entire anterior border of the hairline lies high on the forehead. The usual mid-frontal island of hair is represented by only a few sparse hairs. The area of denudation extends no farther than 2 cm from the frontal line.

IIIa The area of denudation reaches the mid-coronal line.

IVa The area of denudation extends beyond the mid-coronal line, there may be considerable thinning of hair posterior to the actual hair line.

Va Most advanced degree of hairloss; however, the bald area does not reach the vertex.

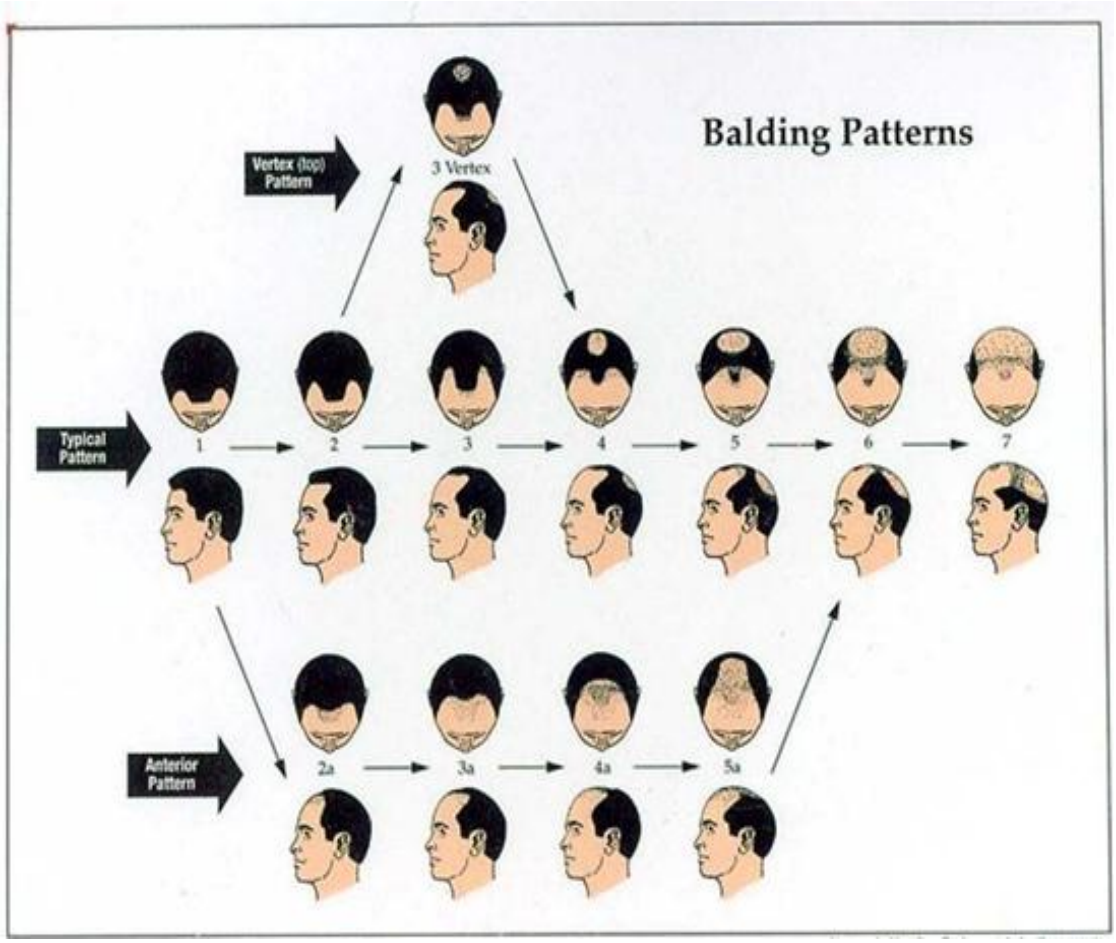


Figure 3: Norwood-Hamilton classification of AGA

Hamilton classification of male AGA[10]:

Hamilton proposed a detailed classification system based on frontoparietal and frontal recessions and frontal thinning, which consisted of eight evolutionary aspects and three subgroups [Figure 4]. They include :

a) scalps, which are not bald (Types I-III)

b) scalps, which are bald (Types IV-VIII)

Type I: There is an absence of bilateral recessions along the anterior hairline in the frontoparietal regions. Type IA is a variant form in which the entire anterior hairline lies high on the forehead.

Type II: The anterior hairline in the frontoparietal regions has symmetrical triangular areas of recession, which extend no farther posteriorly than a point 3 cm anterior to a line drawn in a coronal plane between the external auditory meatuses. Hair is also lost, or sparse, along the midfrontal border of the scalp but the depth of the affected area is much less than in the frontoparietal regions.

Type III: Borderline cases were included separately as Type III. This list also included scalps in which classification is rendered inaccurate due to scars, lateral asymmetry in denudation, unusual types of sparseness and thinning of the hair, and other factors.

Type IV: It this, minimal denudation is considered sufficient to represent baldness. There are deep frontotemporal recessions, usually symmetrical, and are either bare or very sparsely covered by hair. These recessions extend farther posteriorly than a point, which lies 3 cm anterior to a coronal line drawn between the external auditory meatuses. Type IVA is a variant in which hair is sparse or lacking as a broad band along the entire anterior border of the hairline.

Type V: It represents extensive frontoparietal and frontal recessions with a sparseness or absence of hair on the crown.

Type VI: The tonsural region of alopecia remains separated from more anteriorly located areas of hair loss by a laterally-directed bar of scalp in which the hair is only slightly sparse. An island of hair lies in the midline anterior to this laterally-directed hairy bridge. In the Type VIA variant, the peninsula or island of mid-frontal hair is sparse or lost.

Type VII and VIII: In these types, the horseshoe-shaped area of sparse hair or of hair loss is unbroken by any well-haired, laterally-directed bridge of scalp. These are a

result of the spread and confluence of the tonsural and the anteriorly located regions of alopecia.

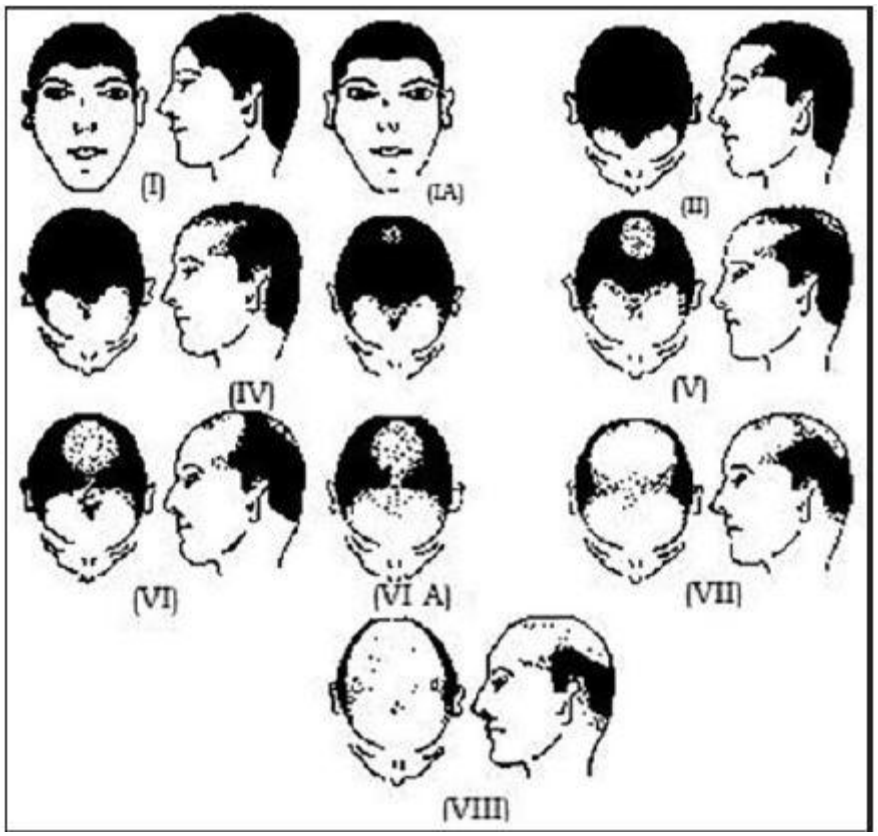


Figure 4 : Hamilton classification of male patterned hair loss

Blanchard and Blanchard classification of male AGA[10]:

Blanchard proposed a different classification with six evolutional stages determined by six measurements: glabello-frontal, superciliary frontal, interparietal, fronto-vertical, helicon-vertical, and nucho-vertical distances. It is not so commonly used as it was difficult to apply and needs taking multiple measurements in every patient for the purpose of classification, which is a tiresome task. [figure 5]

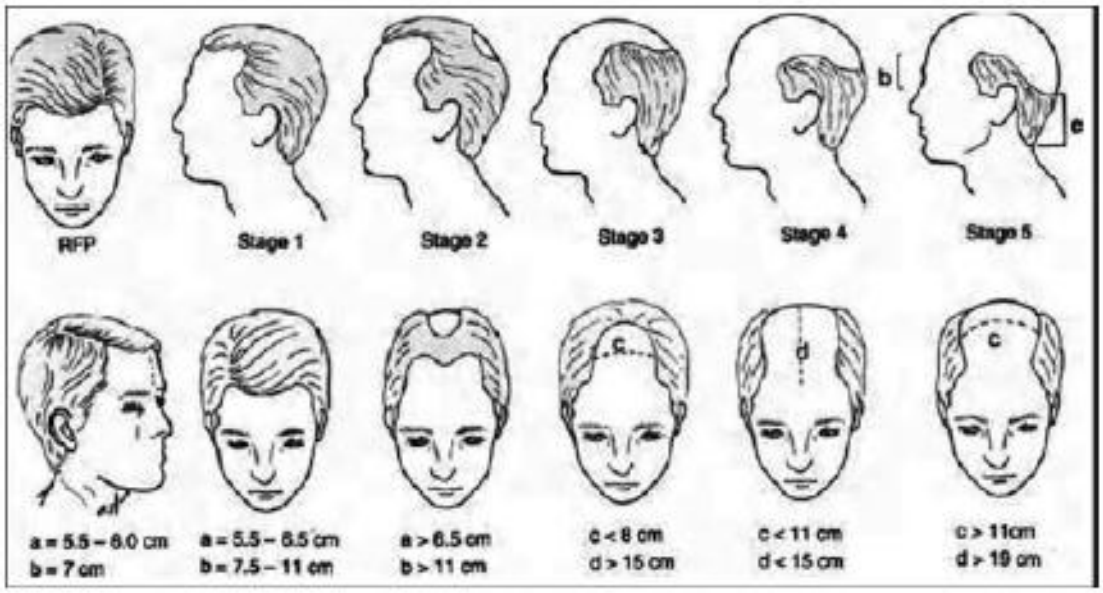


Figure 5: Blanchard classification of hair loss

Koo classification of male AGA[10] :

In this classification, the male patterned baldness is classified into six subtypes by the English alphabetical letter shape of the bald area [Figure 6]. The various subtypes include the following

A) Type M: Both sides of the frontotemporal hairlines look triangular or like the letter M.

B) Type C: The anterior hairline looks like a half-circle or the letter C. Both M and C types do not have hair loss on the vertex.

C) Type O: There is a round or ovoid denuded patch on the vertex or occiput while the anterior hairline is well-preserved

D) Type U: Recession of the anterior hairline progresses over the vertex, which looks like a horseshoe or the letter U.

E, F) Types MO and CO: When recession of the frontotemporal hairline exists, with a denuded patch on the vertex, as combined patterns, these are types MO and CO, according to the shape of the recession of the anterior hairline

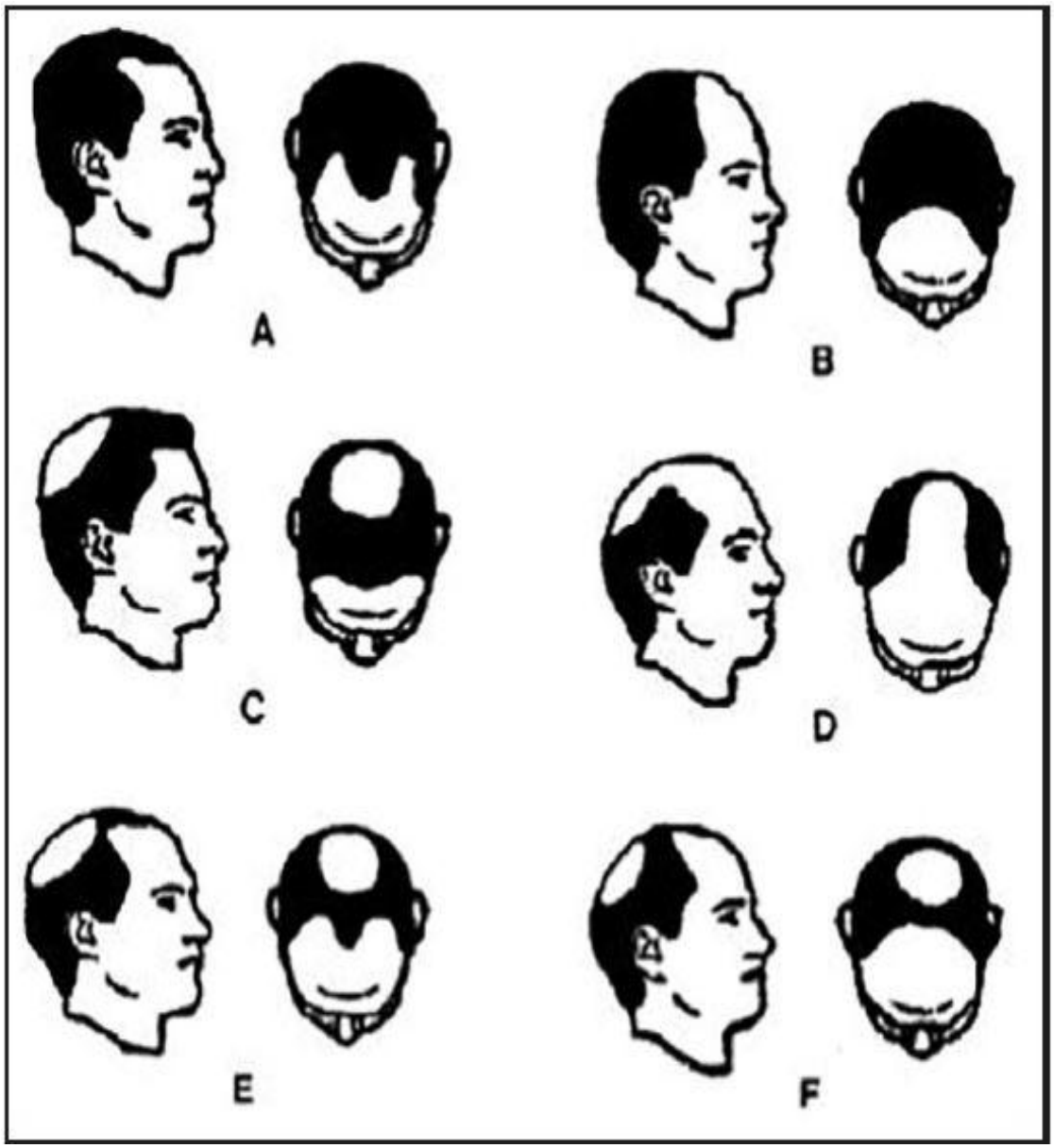


Figure 6: Koo classification of patterned hair loss

Basic and specific classification (BASP) [5,10] :

It is a newer, systematic and universal classification suggested by Lee, *et al*. which is irrespective of sex [figure:7]. Broadly, classified into basic and specific types. The basic (BA) types denote the shape of the anterior hairline, and the specific types (SP) correspond to the density of hair on distinct areas (frontal and vertex). There are four basic types (L, M, C, and U) and two specific types (F and V).

The final type is decided by the combination of the assigned basic and specific types. The basic types are classified by the English alphabetical letter shape of the anterior hairline, except L type, which means linear.

Type L – No hair line recession is observed along the anterior border in the frontotemporal region. It appears a linear.

Type M – Recession of hairline in the frontotemporal region is more prominent than the mid-anterior hairline. The hairline resembles the English alphabetical letter shape M.

Type C – More prominent recession in the mid-anterior hairline is seen than the frontotemporal hairline. There is a regression of entire anterior hairline posteriorly in the shape of half-circle, similar to the letter C.

Type U – The entire anterior hairline regresses posteriorly beyond the vertex forming a horseshoe shape, similar to the letter U.

Type F – This indicates a generalised decrease in the hair density over the entire scalp, not considering the type of anterior hairline. It is usually more marked over the frontal scalp

Type V – More distinct hair loss is seen in the vertex scalp than in the frontal area.

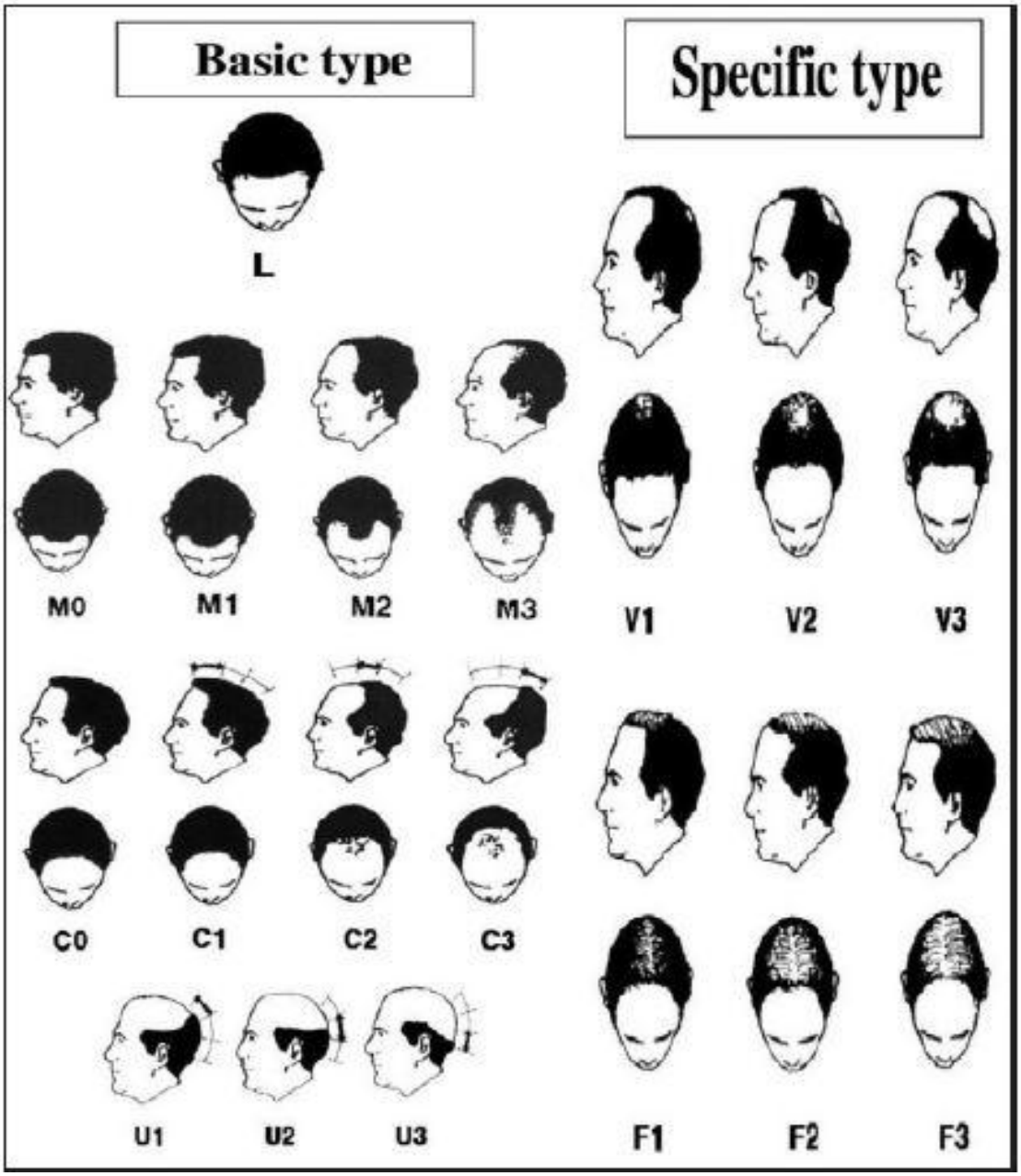


Figure 7: BASP classification of hair loss

Management:

1) Diagnosis [5]:

a) History:

A appropriate history frequently helps to exclude other causes of the hair loss like telogen effluvium. The typical history in all patients of AGA in men is long duration of hair loss with thinning mainly over the frontal, parietal or vertex areas. Past history of systemic diseases, new medications particularly within the last one year should be taken. Usually family history is positive for AGA.

b) General scalp and hair examination:

The scalp is generally normal in AGA, but factors that worsen the condition like seborrheic dermatitis should be ruled out. The pattern of hair loss should be identified.

c) Pull test [6]:

It is a simple method to assess the severity of hair loss. About 20-60 hairs are grasped between the thumb, the index and middle fingers. The hairs are then gently but firmly pulled. A negative test (six or less hairs/less than 10% obtained) point toward normal shedding, whereas a positive test (more than six hairs or 10% obtained) indicates definite and active hair shedding. Shampooing should not be done for 24 hrs prior to a pull test. In patients with AGA the test is generally negative except in the active phase and that too only in the affected sites like the frontal area. A diffusely positive pull test all over the scalp hints the possibility of other diagnosis like telogen effluvium. [figure 8]

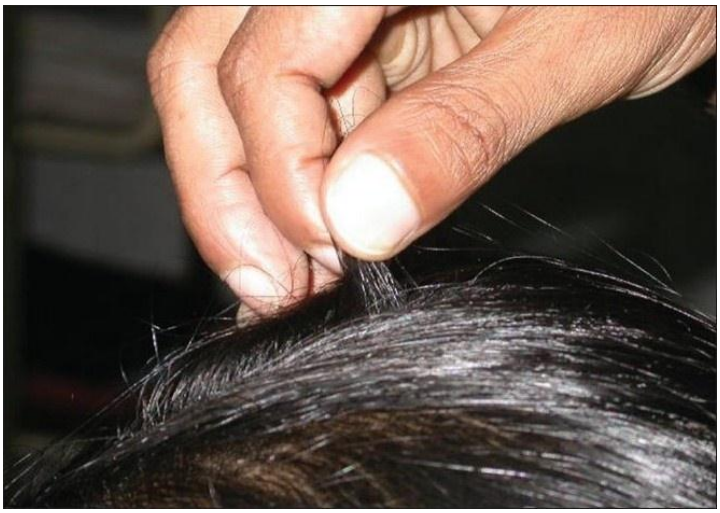


Figure 8: Pull test

d) Trichoscopy[5] :

Trichoscopy has emerged as an essential tool in the diagnosis of AGA. Important features of AGA on trichoscopy are hair diameter diversity (HDD) greater than 20% (which corresponds to vellus transformation), perifollicular pigmentation/peripilar sign and yellow dot [Figure 9]. The term 'anisotrichosis' has been proposed to describe the diversity of hair diameter seen in AGA.

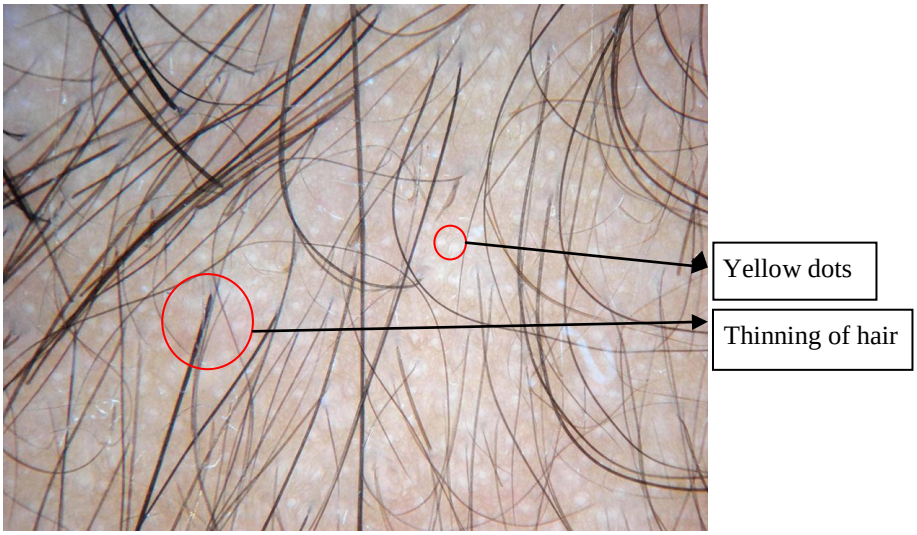


Figure 9 : Trichoscopy 10X

e) Scalp biopsy [5]:

Scalp biopsy is not routinely advised in AGA. The sample is usually taken from the centre of the most affected areas. Sampling from the bitemporal area are better avoided as this area usually have miniaturized hairs even in the absence of AGA. Using a 4 mm punch, two biopsies should be taken ideally – one for transverse sectioning and the other for horizontal sectioning. The horizontal section gives an overview of the number, density and morphology of the follicles. Terminal to vellus hair ratio is normally greater than 7:1, while in AGA it is generally less than 3:1. Other main findings which might be seen in AGA include increased follicular streamers, increased telogen to anagen ratio and a minimal lymphohistiocytic infiltrate perifollicularly with or without mild fibrosis around the upper part of the follicle.

f) Global photography [5]:

A global photograph of scalp area of a hair loss patient is a useful tool for assessing treatment response during follow-up. This requires a cooperative patient with clean, dry hair and a technician who is able to take the time to comb and prepare the hair exactly the same way at each clinical visit. The patient should also be advised to maintain the same hair style and color as of the first visit. Multiple photograph should be taken covering all scalp areas. The four basic views usually preferred are the vertex, mid-pattern, frontal, and temporal views. The key to good global photography is standardization of image with respect to magnification, position and lighting which can be best achieved by using a stereotactic imaging apparatus. Global images are considered to be the key element in evaluation of hair growth, as the whole scalp hair is evaluated in a uniform way.

2) Treatment:

There are multiple modalities of treatment which are tabulated in Table 1

Table 1: Therapeutic options for AGA[5,6]

Medical		**Surgery**	**other options**
Topical	**Systemic**		
Minoxidil 2%-5% Tretinoin 0.025% Azelaic acid 5% Ketoconazole 2% Fluridil Latanoprost Growth factors	5-Alpha reductase inhibitors : *Finasteride* *Dutasteride*	-Hair transplantation: - *Strip harvesting* - *Follicular unit harvesting* - Scalp reduction - Scalp flaps	-Laser therapy -Supportive therapy: - Wigs - Hair piece - Prostheses

Medical management:

Minoxidil: Since 1960s, oral minoxidil has been used to treat hypertension. Hypertrichosis was observed as a consequence of minoxidil treatment which led to the development of topical minoxidil as a treatment for hair loss. FDA has approved topical minoxidil for the treatment of male AGA in 1984.[4]

Proposed Mechanisms of action:[5,6]

- Vasodilatory properties due to opening of ATP-sensitive potassium channels of cell membranes after conversion to active form minoxidil sulfate.
- Angiogenic properties by increased expression of VEGF mRNA in the dermal papillae.
- Stimulation of prostaglandin endoperoxidase synthase-1 that increases the follicular levels of PGE_2 resulting in the prolongation of anagen phase and the increase in size of hair follicle.
- Increased expression of hepatocyte growth factor (HGF) m-RNA, a hair growth promoter.
- Extends the anagen phase by activating β-catenin activity in the DPCs. According to recent studies, maintenance of β-catenin activity in the DPCs enables hair follicles to keep actively growing.[8,9]

Minoxidil topical preparations are available as 2%, 5%, 10%, 12.5 % solutions, foams and gels. Both 5% and 10% solutions are currently in use for treatment in males.[4] Human studies have shown that minoxidil increases hair count, linear growth and also diameter of hair. The increase in hair count is usually evident within 6-8 weeks of treatment initiation and peaks by 12-16 weeks.[11]

Most common side effect reported with topical minoxidil is hypertrichosis of face.[6] Itching of scalp, increased scaling and erythema may be seen.[4] Irritant and allergic contact dermatitis may also occur, most commonly due to propylene glycol content of the solution.[5]

Delivery of minoxidil to hair follicles and related cells is important in the treatment of alopecia. Fang *et al,* has reported the development of squarticles, which

are nanoparticles formed from sebum-derived lipid such as squalene and fatty esters. These are used in attaining targeted drug delivery to the follicles. Two different nanosystems, nanostructure lipid carriers (NLC) and nanoemulsions (NE), were prepared which provided a promising nanocarrier for topical delivery of minoxidil in vivo.[12]

5-α reductase inhibitors:

There is an inherited sensitivity of the hair follicles to DHT in AGA. The enzyme 5-alpha-reductase converts testosterone to its active form DHT. Two types of 5-alpha-reductase are seen in humans. Type I predominates in the liver, skin and scalp while type II is mainly seen in prostate, genitourinary tract and the hair follicle. Drugs used in AGA are finasteride and dutasteride. Finasterisde is a type II 5-alpha-reductase-inhibitor while dutasteride, inhibits both type I and type II iso enzymes.[5]

Recommended dosage of oral finasteride to improve or to prevent progression of AGA is 1 mg daily in male patients above 18 years with mild to moderate AGA. Oral dutasteride 0.5 mg daily is another option, but only few studies are available to compare its efficacy with finasteride. [5] According to Shanshanwal *et al.,* dutasteride was shown to be efficacious than finasteride in male AGA in a 6 months controlled study.[13]

Topical finasteride is not an effective option for AGA. Studies in both humans and animals have shown that the combination of minoxidil 5% and oral finasteride 1 mg daily is more effective than finasteride or minoxidil mono-therapies. Combining hair transplant with oral finasteride is also considered to be superior than hair transplant alone. Main concern while treating male patients for AGA with oral finasteride are sexual side effects.[5] Long term studies have reported rare adverse

effects of erectile dysfunction in 1.4% and loss of libido is observed in 1.9% of the patients in the first year.[4,5]

Following are the other medical treatment options:[4]

- ***Topical antiandrogens:*** Fluridil has been developed for use in AGA. It is designed in a way to get locally metabolized, not systemically resorbable and degradable into inactive metabolites without systemic anti-androgenic activity. A recent double-blind, placebo-controlled study has showed an increase in the anagen to telogen ratio in patients using topical fluridil. No side effects on libido and sexual performances have been reported[6].
- ***Latanoprost:*** It is a prostaglandin analogue which stimulates hair growth apparently by extending the anagen phase of hair cycle. According to a recent placebo controlled study patients using latanoprost showed significant increase in hair density compared with baseline.[14, 15]
- ***Topical antifungal:*** In a study by Inui *et al.*, Ketoconazole shampoo has showed comparative increase in hair growth with placebo in both humans and in rodents.[16] It is a good additive treatment and also thought to be having anti-inflammatory and anti-androgenic properties which helps in associated seborrheic dermatitis.[17]
- ***Growth factors:*** Hair follicle growth and development is influenced by a number of growth factors and cytokines. A phase 1, double-blind clinical trial designed to evaluate the safety of a bioengineered, nonrecombinant, human cell-derived formulation containing follistatin, keratinocyte growth factor (KGF), and VEGF was performed to assess the efficacy in stimulating hair growth. It showed a significant increase in total hair count after single intradermal injection without any adverse reaction.[18] In

a study by Navarro *et al.*, intradermal injection of plasma rich in growth factors (PRGF) into the scalp is a safe and effective treatment for AGA and also shows that PRGF exerts improved anagen/telogen results than topical minoxidil alone.[19]

Surgical treatments:

Hair transplantation procedure involves removal of hair from the back and sides of the scalp and reimplantation into the bald vertex and frontal scalp. Horse shoe shaped (horizontal) area in the occipital region is considered as a 'safe donor area'.[5]

- ***Strip harvesting:*** A strip of scalp of about 8-14 mm and 20-30 cm is removed from the occipital scalp under local anaesthesia, and the wound is then sutured back together. The donor hair is then divided into separate follicular units which is transplanted into the balding area. The main disadvantage in this technique is that, the wound heals with a linear scar in the donor occipital area.[4,5,20,21]
- ***Follicular unit extraction (FUE) harvesting:*** Individual follicles are removed from occipital scalp under local anaesthesia with 1mm punch biopsies. Each unit is then reinserted back into the balding scalp using a microblade. In this method, there are no visible scars seen after healing as single follicular units are removed instead of large amount of tissue as in strip harvesting.[4,5,20,21]
- ***Combination of two*** : In this, a strip is marked out on the scalp. FUE method is then used to remove follicular units from above and below the marked strip

of scalp. The advantage in this method is more number of grafts can be obtained for mega-sessions.[5]

Scalp flap and scalp reduction surgeries are not frequently used at present as a treatment modality for AGA.[20,21]

Laser therapy:

A variety of laser and light sources have been tried for treatment of hair loss, with varied success. The mechanism of low-level lasers on hair growth is hypothesized that the light enhances mitochondrial respiratory activity.[22] Light of 650-900 nm wavelengths at 5mW has been suggested as an effective option for AGA.[5]

Other cosmetic options:

A topical combination of caffeine, niacinamide, panthenol, dimethicone and an acrylate polymer (CNDPA) has shown to increase the hair fiber diameter which enhances the cosmetic appearance of patients with thinning hair.[5, 23]

Future developments:

The use of bio-engineered hair follicles derived from stem cells has found to be effective in animal studies and in future this could be a definite option for AGA.[5, 24]

In vitro studies have demonstrated good results with copper peptides, but at present there is no real scientific evidence to support the same.

Topical valproic acid and hair stimulating complex (HSC) acts via Wnt/β-catenin activation promotes hair growth. Tetrapeptides, diguanosine tetraphosphate (GP4G), biotin, zinc, omega 3 fatty acids and antioxidants , topical caffeine, melatonin, roxithromycin are some of the new therapies.[25]

Microneedling:

Microneedling is a minimally invasive therapeutic procedure involving superficial and controlled puncturing of the skin by rolling with miniature fine needles.

Basic instrument:

The standard medical dermaroller has a 12 cm long handle with a 2 × 2 cm wide drumshaped cylinder at one end studded with 8 rows and 24 circular arrays of 192 fine microneedles, usually 0.5–3 mm in length and 0.1–0.25 mm in diameter. These single use microneedles are synthesized by reactive ion etching techniques on silicon or medical grade stainless steel.[26]

Principle :

It is a technique which works by stimulation of stem cells and inducing activation of growth factors. Micropunctures are created using microneedles which produce a controlled skin injury without actually damaging the epidermis. These microinjuries lead to minimal superficial bleeding and set up a wound healing cascade with release of various growth factors such as platelet derived growth factor (PDGF), TGF-α and TGF-β,

connective tissue activating protein, connective tissue growth factor, and fibroblast growth factor (FGF).[3]

The DP is a site of expression of various hair growth related genes and plays a key role in the regulation of hair cycling and growth.[3]

Mechanisms of hair regrowth by microneedling :[27,28]

- Release of PDGF, epidermal growth factors are increased through platelet activation and skin wound regeneration mechanism.
- Activation of stem cells in the hair bulge area under wound healing conditions which is caused by a dermaroller.
- Overexpression of growth related-genes, VEGF, β catenin, Wnt3a, and Wnt10 b.

Applications in dermatology [26]:

1. Skin rejuvenation
2. Scars: Acne scars, Post-burn scars, hypertrophic scars, varicella scars, post- traumatic scars
3. Androgenetic alopecia and alopecia areata
4. Pigmentation- melasma, periorbital hypermelanosis
5. Stretch marks
6. Transdermal delivery of drugs :
    - Topical tretinoin and vitamin C for the treatment of acne scarring and skin rejuvenation.
    - Penetration enhancement of minoxidil and platelet rich plasma for androgenetic alopecia.

- Enhances the effect of 5-aminolevulinic acid for more efficacious photodynamic therapy, when used in combination for the treatment of actinic keratosis and photoaging.

Contraindications [26]:

1. Active acne
2. Herpes labialis or any other local infection such as warts
3. Moderate to severe chronic skin disease such as eczema and psoriasis
4. Blood dyscrasias, patients on anticoagulant therapy
5. Extreme keloidal tendency
6. Patient on chemo/radiotherapy.

In a Study by Jeong *et al.*[27] 10 mice were divided into 5 groups and each group dorsal skin was depilated. Disktype roller was applied to each group during 4 weeks (5 times a week) according to microneedle length such as 0.15 mm, 0.25 mm, 0.5 mm, 1.0 mm. After obtaining microneedle length for hair growing, most effective rolling cycle determining experiment was carried out such as 3, 6, 10, 13 cycles. Hair growing after microneedle stimulation was evaluated with photograph and handheld digital microscope. Specimens were obtained by excision biopsy and immunohistochemistry, RT-PCR study done to know hair follicle status and its related growth factors. Microneedling stimulation group have shown the enhanced expression of hair related genes and stimulation of hair .

In a study by Kim *et al.*[28] mice were divided into seven groups: negative control group, positive control group (50% ethanol), 3% minoxidil group, horizontal wound group, vertical wound group, 0.25-mm-sized microneedle roller group, and 0.5-mm-sized microneedle roller group. Microneedle roller treated groups showed earlier and faster hair growth than untreated mice group. Also, the hair induced by microneedle roller was shinier than the hair induced by minoxidil. Increased expression of hair follicle growth related molecules in microneedle roller treated group was also confirmed by immunoblotting and RT-PCR.

In a study by Dhurat *et al.*[3] 100 men with AGA were divided into microneedling group and minoxidil group, with 50 members in each group. All patients scalp was shaved off before treatment to ensure equal length of hair shaft at baseline. In the Microneedling group, patients received a weekly microneedling procedure (dermaroller of 1.5mm sized needles) on the scalp along with 1 ml of 5% Minoxidil solution applied twice daily. In Minoxidil group, patient applied only 1 ml of 5% Minoxidil lotion twice daily. Ninety four of the 100 patients completed the 12 week study period of which 50 were of Microneedling group and 44 subjects were of Minoxidil group. The mean change in hair count at week 12 was significantly higher in the microneedling group compared to the minoxidil group.

With the available literature on microneedling in AGA in men, it is evident that it is a safe and a promising tool in hair stimulation for male pattern baldness and also is useful to treat hair loss refractory to minoxidil

therapy. Moreover microneedling is a non expensive procedure which is affordable to all class of patients. The side effects of microneedling procedure are negligible. The present study was undertaken to determine the efficacy of combination of topical minoxidil and microneedling versus minoxidil alone in AGA in men.

METHODOLOGY

SOURCE OF DATA :

A hospital based prospective and single observer blinded study was conducted in the department of Dermatology, Venereology and Leprosy of B.L.D.E.U's Shri. B.M. Patil Medical College Hospital and Research Centre, Vijayapur. Sixty eight male patients with AGA were recruited for the study. The study was conducted during the period of November 2015 to May 2017.

METHOD OF COLLECTION OF DATA:

Age matched (± 5 years) male patients of age group 18 years to 40 years with AGA grade III and IV were enrolled for the study. 34 patients each were taken as cases and controls.

Inclusion criteria:

1. Male patients of 18 - 40 years age group with AGA grade III and IV.

Exclusion criteria:

1. Men on finasteride or any other androgenic medications in past 6 months and any systemic illnesses like diabetes mellitus and hypertension.

2. Patients with history of bleeding disorders.

3. Patients on anti-coagulant medications (aspirin, warfarin, heparin).

4. Patients with active infection at the local site.

5. Patients with keloidal tendency.

6. Patients with history of psoriasis or lichen planus because of the risk of Koebner phenomenon.

Methods:

Detailed history with respect to the onset and duration of hair loss, any treatment (anti-androgenic medications) received within past 6 months, and pre-existing medical conditions were recorded (proforma enclosed).

Initial clinical examination of the patient was done by one of the investigators to determine the grade of hair loss using Norwood-Hamilton classification chart. These findings were recorded in the proforma (first visit record). Informed consent for the study was undertaken from all the patients.

Sixty eight cases of AGA grade III and IV were allocated randomly into 'study' (N = 34) and 'control' (N = 34) groups based on patients feasibility for weekly follow-up. Each patient was studied for 12 weeks. Patients in the 'study' group were offered 'microneedling' treatment on scalp along with 1 ml of 5% minoxidil solution applied twice daily. Patients in the control group were given only 5% minoxidil solution 1ml for twice daily application for a period of 12 weeks. Baseline clinical photographs were taken.

Microneedling was done for the patients in the 'study' group weekly for 4 sessions initially, and thereafter fortnightly for subsequent 4 sessions, covering the total duration of 12 weeks. Post treatment clinical photographs were taken at the end of 12 weeks for patients in both the groups.

Methodology:

Equipments:

i. *Dermaroller:* The standard dermaroller used for scalp consists of a handle with a drum-shaped roller attached to it at one end (Figure 10). The drum-shaped roller is studded with 192 microneedles in eight rows, 1.5mm in length and 0.25 mm in diameter. The microneedles are synthesized by reactive ion etching techniques on silicon or medical-grade stainless steel. Each dermaroller was used for a minimum of 4 sessions depending on the patient's scalp area. For this study dermaroller (ReGe Roller system) manufactured by Geosmatic Cosmeceutical and Cosmocare Pvt Ltd,Pune, India, was used.

Figure 10: Dermaroller with handle

ii. *Video Dermoscope :* It is a portable and versatile hand held device which has a high resolution and triple light source (normal light, ultraviolet light, polarization light) at one end (figure 11). It has a possibility for connecting to the computer and view the images. For hair-count at baseline and follow-up period, a video dermoscope was used. For this study dermoscope manufactured by Dermaindia, Chennai (Ultracam TLS) was used.

Figure 11: Video dermoscope

Hair count calculation: The test area on scalp in both study and control groups, undertaken for hair count was decided as follows: one square inch area on the vertex with thinning of hair was selected for each patient. The distance of this area on all sides (anteriorly from glabella, posteriorly from occiput, and laterally from the tips of both the ear helices) was measured and recorded in proforma for reproducing during follow up. This area was defined and marked using a skin marking pencil at baseline and again during follow up. The square area was divided into 4 equal quadrants by a vertical and a horizontal lines (Figure 12). Digital images were taken from each quadrant separately using the video dermoscope at baseline and at the end of 12 weeks. Hair count was done by two investigators on computer screen at magnification on both the occasions. All digital images were preserved as record.

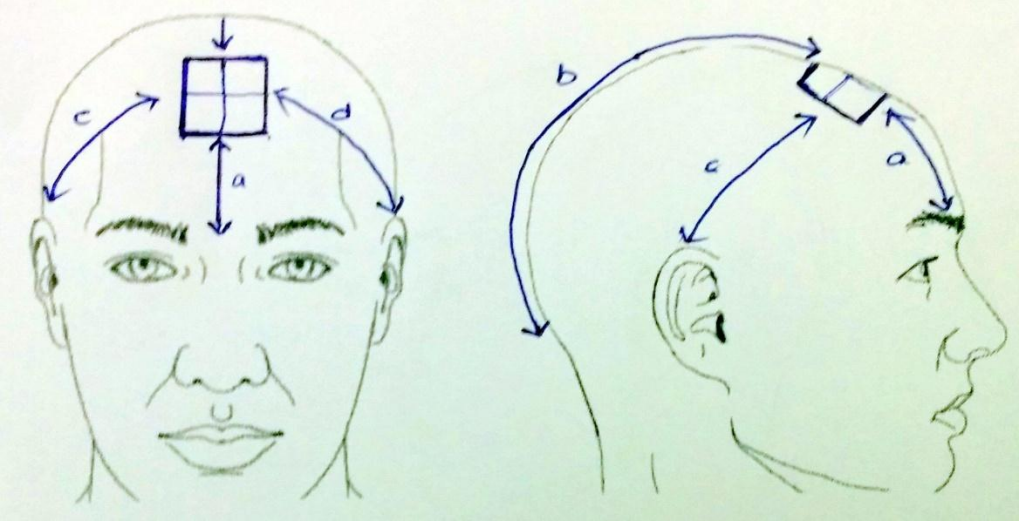


Figure 12: Measurements of the test area on vertex to be used for hair count

Microneedling procedure *:*

The scalp was cleaned with betadine and normal saline. A dermaroller of needle size 1.5 mm was rolled over the affected areas of the scalp in a longitudinal, vertical, and diagonal directions until mild erythema is noted, which was considered as the end point of the procedure. All patients were instructed not to apply minoxidil on the day of procedure and to resume its application only 24 hours after the microneedling procedure. The patients were also instructed to apply minoxidil on dry scalp and not to use any other hair oil while using minoxidil.

FOLLOW -UP:

Patients in both the groups were followed up for a period of 12 weeks. The patients in 'study' group were asked to come for next microneedling session weekly for first 4 consecutive weeks and thereafter for every 2 weeks for a period of 8 weeks. The patients in the 'control' group were asked to come for routine visit for every 4 weeks for a period of 12 weeks. During each visit, the findings related to treatment

response like decrease in hair fall, appearance of new hair and patients' general perception regarding the treatment were recorded. Any adverse effects related to therapy was recorded in the proforma at each visit. At the end of 12 weeks the final response was evaluated according to the above- mentioned procedure.

EFFICACY EVALUATION:

The 2 primary efficacy parameters were assessed:

i) Increase from baseline hair count at 12 weeks (done by the investigators as per above protocol).

ii) Patient self assessment of hair growth at 12 weeks; patients in both the groups were asked to mark their perception regarding hair growth on a 10 inch long 'visual analog scale (VAS)' of 0-10 as shown in figure 13 (0: No improvement; 1: 10% improvement; 2: 20% improvement; 3: 30% improvement; 4: 40 % improvement; 5: 50% improvement; 6: 60% improvement, 7: 70% improvement; 8: 80% improvement; 9: 90% improvement; 10: 100% improvement).

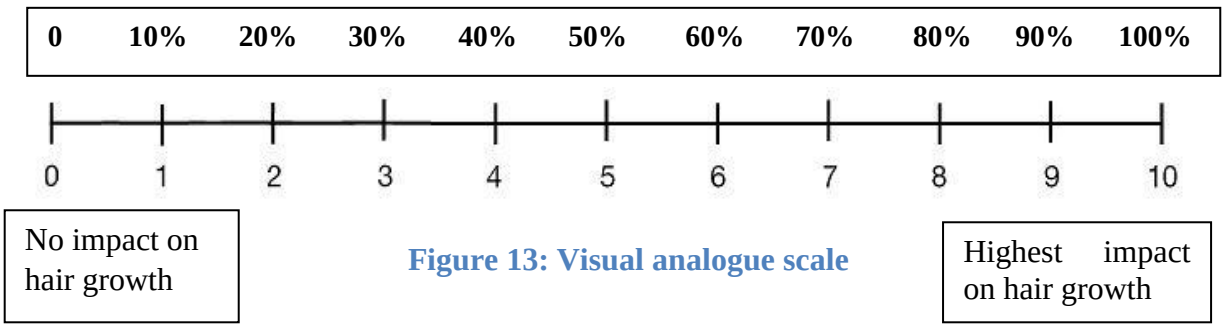


Figure 13: Visual analogue scale

STATISTICAL ANALYSIS:

Clinico-epidemiological data collected from the patients were compared using paired and unpaired *t*-test, Wilcoxon match pairs test, Mann Whitney U test , chi square test. Mean ± SD and diagrammatic presentation of these values were used to present the data.

ETHICAL CLEARANCE:

Institutional ethical committee clearance was undertaken for the study.

Figure 14a and 14b are the clinical photographs showing grade 3 response on 10-inch visual analog scale in a patient of study group. Figure 15a and 15b are the clinical photographs showing grade 1 response on 10-inch visual analog scale in a patient of control group.

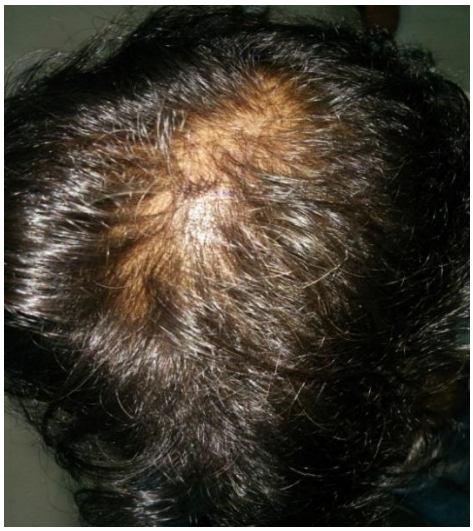


Figure 14a: Baseline (study subject)

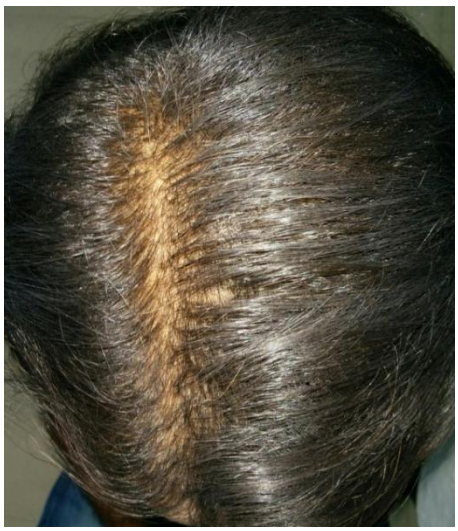


Figure 14b: After 12 weeks (study subject)

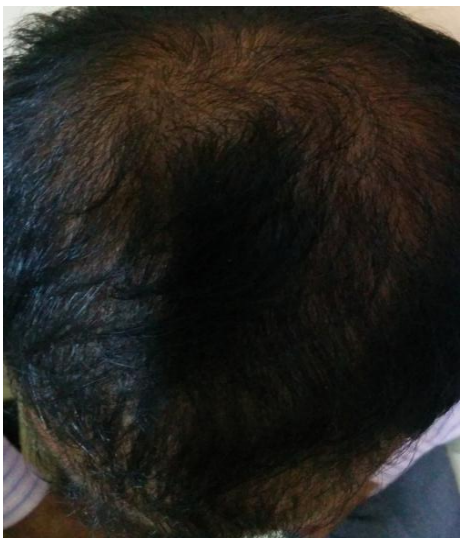


Figure 15a: Baseline (control subject)

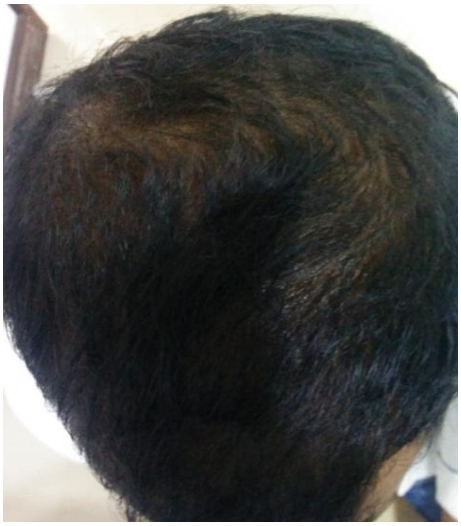


Figure 15b: After 12 weeks (control subject)

Figure 16a and 16b are Dermoscopic pictures showing grade 3 response on 10-inch visual analog scale in a patient of study group. Figure 17a and 17b are the dermoscopic pictures showing grade 1 response on 10-inch visual analog scale in a patient of control group.

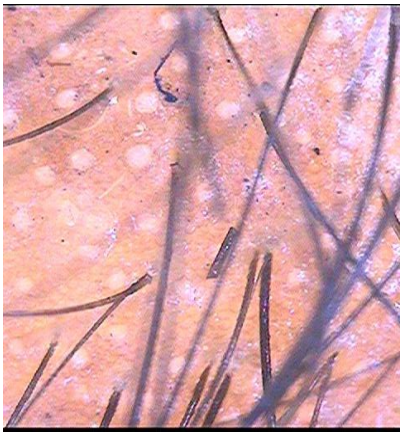


Figure 16a: Baseline (study subject)

Figure 16b: After 12 weeks (study subject)

Figure 17a: Baseline (control subject)

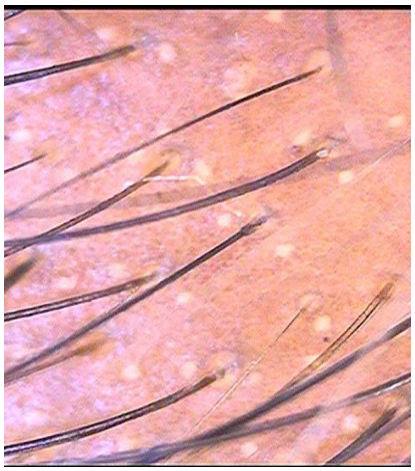


Figure 17b: After 12 weeks (control subject)

RESULTS

A hospital based prospective and single observer blinded study was conducted from November 2015 to May 2017. A total of sixty eight male patients with androgenetic alopecia were included in the study. They were randomly allocated into study and control groups with 34 subjects in each group.

Age Distribution :

The age of the patients enrolled in the study group ranged from 18 to 38 years. The mean age (± SD) of the study population was 27.53 (± 5.142) years. The age of the patients enrolled in the control group ranged from 18 to 34 years. The mean age (± SD) of the control group was 24.56 (± 3.386) years. The maximum number of patients were in the age group 23 to 26 years in both the groups. Figure 7 presents the age distribution of the patients wit of both study and control groups.

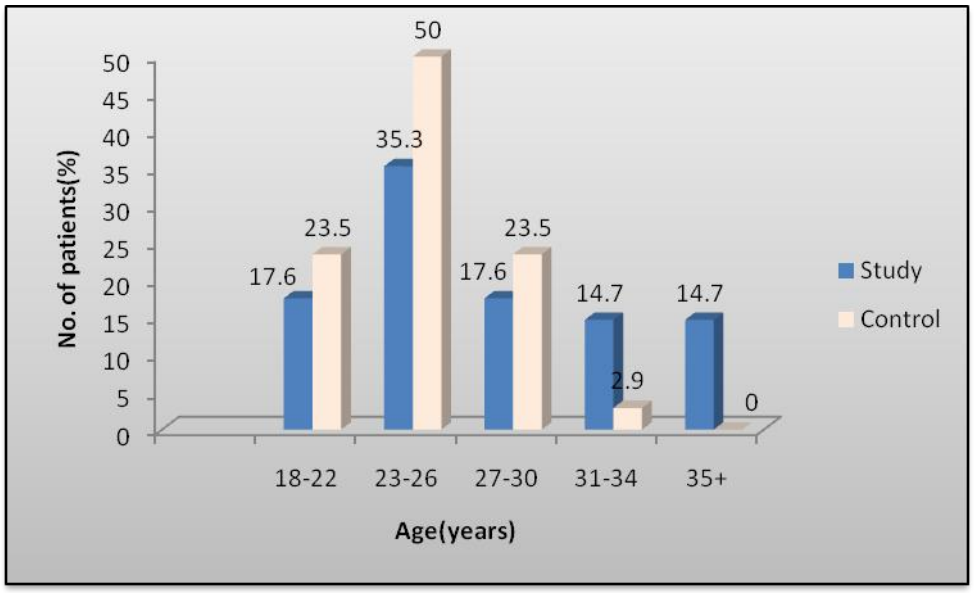


Figure 7: Age distribution of patients

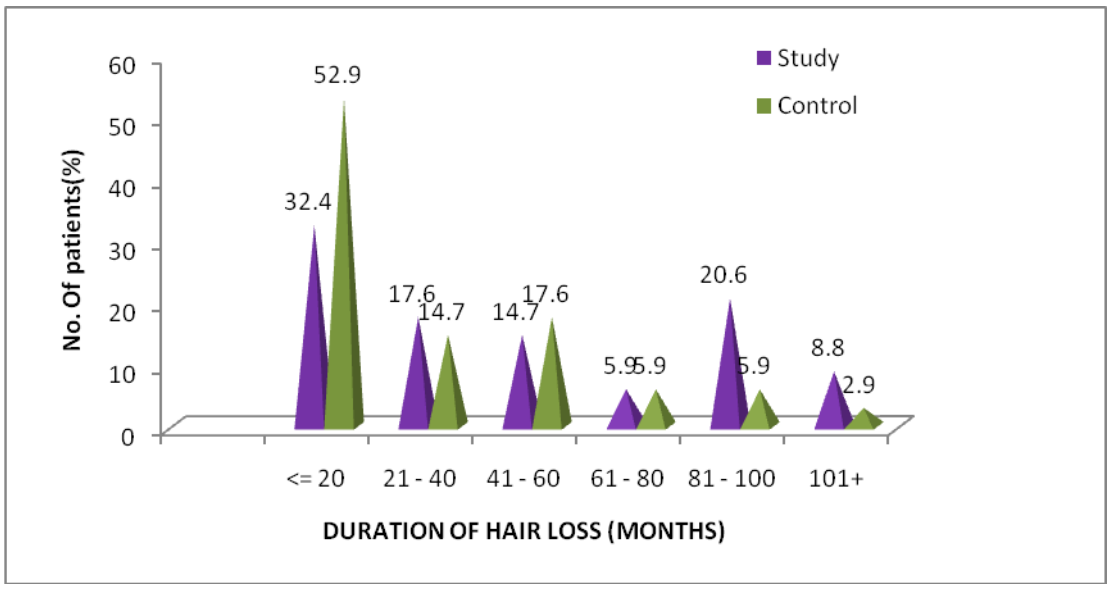
Age of onset of hair loss:

The age of onset of hair loss of the patients enrolled in the study group ranged from 18 to 32 years. The mean age (± SD) of onset of hair loss of the study population was 23.56 (± 3.295) years. The age of onset of hair loss of the patients enrolled in the control group ranged from 14 to 30 years. The mean age (± SD) of onset of hair loss of the control group was 21.71 (± 3.398) years.

Duration of hair loss:

The duration of hair loss of the patients enrolled in both the groups ranged from 6 months to 10 years. The mean duration (± SD) of hair loss of the study population was 49.62 (± 37.979) months. The mean duration (± SD) of hair loss of the control group was 31.71 (± 29.526) months. The duration of hair loss in maximum number of patients in both groups was less than 1.8 years. Figure 8 presents the distribution of the patients according to duration of hair loss of both study and control groups.

Figure 8 : Distribution of patients according to duration of hair loss



Previous treatment history:

History of receiving treatment in the past for AGA was present in 21(30.8%) patients. In study group 11 (32.4%) took previous treatment compared to 10 (29.4%) in control group. Figure 9 presents the distribution of the patients according to history of previous treatment of both study and control groups.

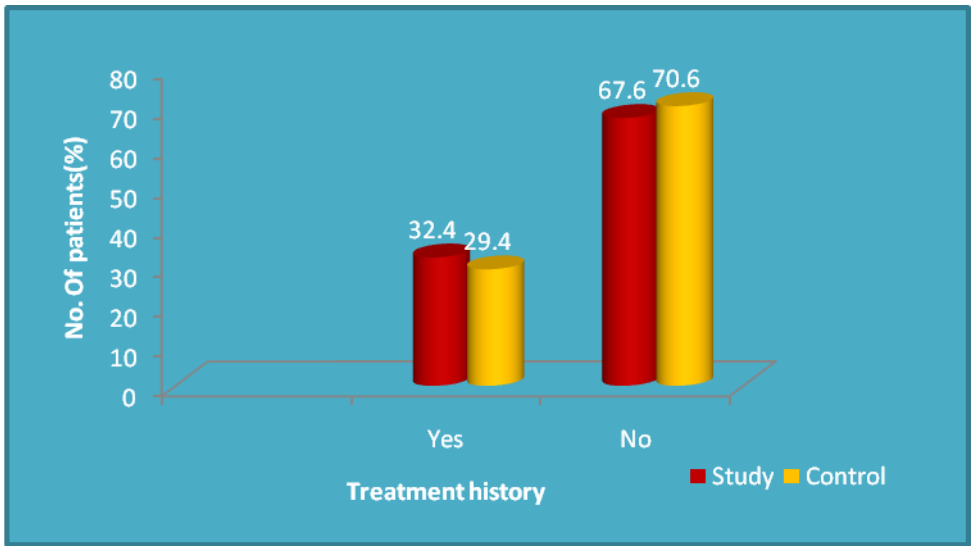


Figure 9: Distribution of patients according to previous treatment

Family history:

Family history of AGA was present in 30 (44.11%) patients in both the groups. In study group 16 (47%) had family history of AGA compared to 14 (41.2%) patients in control group. Figure 10 presents the distribution of the patients according to family history of AGA in both study and control groups.

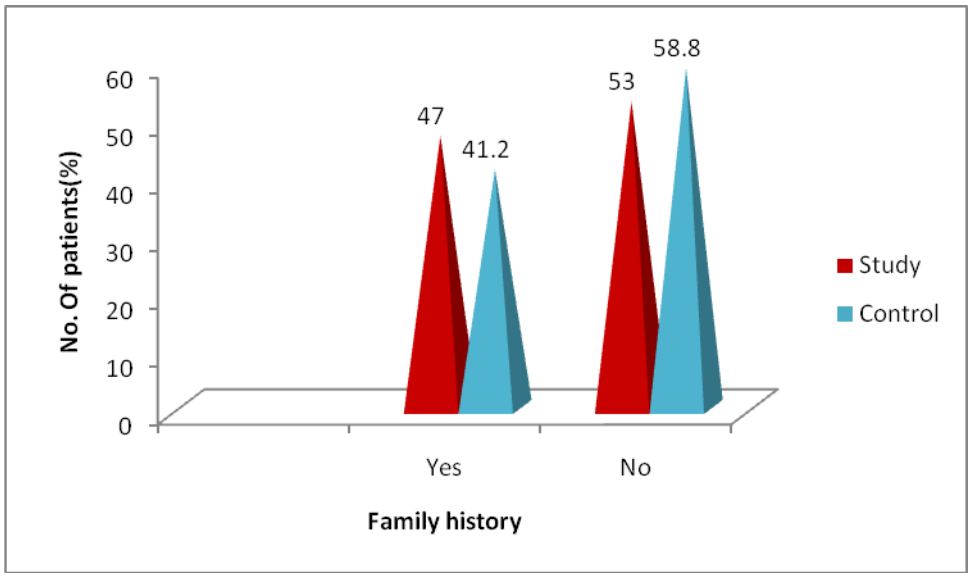


Figure 10: Distribution of patients based on family history of AGA

Grade of hair loss:

Most prevalent type of AGA was grade IV in 22(32.35%) out of 68 patients. In study group 11 (32.4%) had grade IV hair loss, followed by grade IIIv (vertex) type in 7(20.6%), grade IVa (anterior) in 6 (17.6%) and grade III and IIIa (anterior) type in 5 (14.7%) patients each. In control group 11 (32.4%) had grade IV hair loss, followed by grade III type in 8(23.5%), grade IIIv (vertex) in 6 (17.6%), grade III a type in 5 (14.7%) and grade IV in 4 (11.8%) patients. Figure 11 presents the distribution of the patients according to AGA grade in both study and control groups.

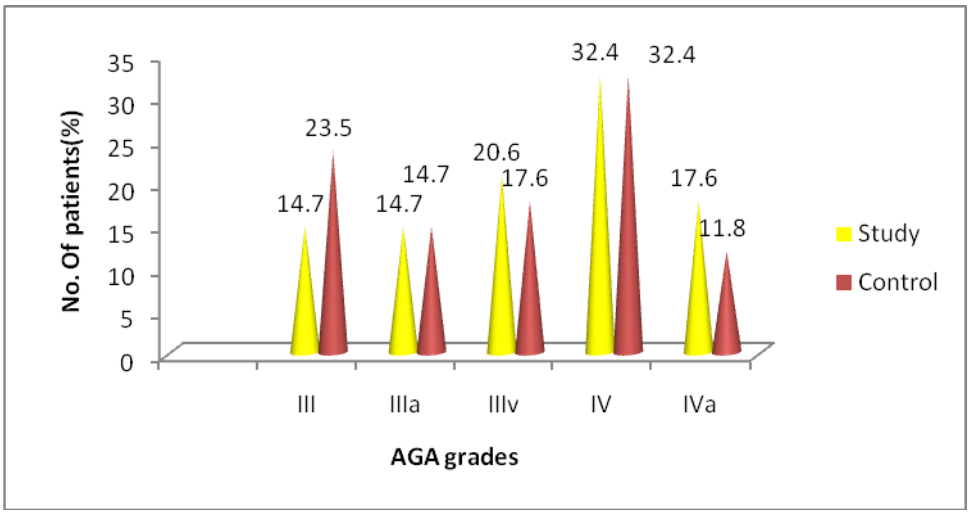


Figure 11: Distribution of patients according to AGA grade

Among 68 patients who were enrolled in the study, 60(88.23%) patients have completed the study at the end of 12 weeks. Eight (11.76%) patients were lost to follow-up. Three patients in study group and five patients in control group were lost to follow-up and they were not considered for efficacy evaluation. So, 31 out of 34 in study group and 29 out of 34 patients in control group were considered for efficacy evaluation.

Patient self assessment of hair growth at 12 weeks:

Patient's perception regarding hair growth at the end of 12 weeks was a primary efficacy parameter. In study group, maximum improvement in hair growth reported was 50 %, observed in 4(12.9%) out of 31 patients. In control group, maximum improvement in hair growth reported was 30 %, seen in 2 (6.9%) out of 29 patients. In study group, most of the patients showed 30 % improvement in hair growth, reported in 11 (35.5%) out of 31 patients. In control group, most of the patients showed 10 % improvement in hair growth, reported in 11 (37.9%) out of 29 patients.

The mean (±SD) patient self assessment of hair growth at the end of 12 weeks study on a visual analogue scale was 2.97±1.28 and 1.21±0.90 in study and control groups respectively which is statistically significant ($p < 0.0001$*). The patient's self assessment of hair growth at the end of 12 weeks has been presented in table 2 and 3.

Table 2: Patient assessment of hair growth at week 12

Patient visual analogue scale (0-10)	**Study N= 31**	**Control N= 29**
0	1(3.2)	7(24.1)
1	3(9.7)	11(37.9)
2	6(19.4)	9(31)
3	11(35.5)	2(6.9)
4	6(19.4)	0
5	4(12.9)	0

Data presented as Number (percentage)

Table 3: Mean patient assessment of hair growth at week 12

Variable	**Study group N=31**	**Control group N=29**	**p value**
Patient assessment of hair growth	2.97(3)±1.28	1.21(1.0)±0.90	<0.0001*

Note: *significant at $p<0.05$, Data presented as Mean±SD

Hair count:

Increase from baseline hair count at 12 weeks was a primary efficacy variable. The mean(± SD) hair count in study group at baseline was 82.35(± 22.56) and at the end of 12 weeks is 94.87 (± 22.82) . The mean(± SD) hair count in control group at baseline was 80.37(± 16.48) and at the end of 12 weeks is 82.27 (±14.72). All subjects of study group have shown increase in target area hair count over 12 weeks ranging from 1 to 30. No increase in target area hair growth was noted in 7 (24.1%) in control group over 12 weeks. The mean increase in hair count at week 12 was significantly greater for study group compared to control group (12.82 Vs. 1.89 respectively, $p < 0.0001$). Increase from baseline hair count at week 12 has been tabulated in tables 4-6.

Table 4: Comparison of hair growth between baseline and after treatment (week 12)

Hair count	Baseline	After treatment	p value
Study group (N=31)	82.35±22.56	94.87±22.82	<0.0001*
Control group (N=29)	80.37±16.48	82.27±14.72	0.2630

Note: *significant at p<0.05, Data presented as Mean±SD

Table 5: Increase in hair count at week 12

Increase in hair count	Study group N =31	Control group N =29
<1	0 (0)	6 (20.68)
1-10	13 (41.9)	21 (71.41)
11-20	14 (45.2)	1 (3.45)
21-30	04 (12.9)	01 (3.45)

Data presented as Number (percentage)

Table 6: Mean increase in hair count at week 12

Variables	**Study group N=31**	**Control group N=29**	**p value**
Increase in hair count	12.82±6.82	1.89±8.94	<0.0001*

Note: *significant at p<0.05, Data presented as Mean±SD

Increase in hair count is not statistically significant in subjects who has received treatment in the past when compared to patients who has not received treatment in both study(p=0.149) and control(p=0.335) groups. The association between history of previous treatment and increase in hair count at week 12 has been presented in table 7-8.

Table 7: Association between treatment history and increase in hair count in study group

Treatment history	Increase in hair count (Study group)				Total	p value
	<1	1-10	11-20	21-30		
Yes	0(0)	2(15.4)	7(50)	1(25)	10(32.2)	0.149
No	0(0)	11(84.6)	7(50)	3(75)	21(67.8)	
Total	0(00)	13(100)	14(100)	4(100)	31	

Data presented as Number (percentage)

Table 8: Association between treatment history and increase in hair count in control group

Treatment history	Increase in hair count (control group)				Total	p value
	<1	1-10	10-20	20-30		
Yes	2(33.3)	5(23.8)	1(100)	0	8 (27.6)	0.335
No	4(66.7)	16(76.2)	0	1(100)	21(72.4)	
Total	6(100)	21(100)	1(100)	1(100)	29	

Data presented as Number (percentage)

Therapy related side effects noted in study group were mild pain during microneedling procedure which was tolerable. No side effects were reported in control group subjects.

Patients in both the groups were advised to continue application of minoxidil 5% solution after 12 weeks of therapy. They were also informed to come for monthly follow up. However, only few patients of study group have continued minoxidil 5 %

application and are on follow up. Patients in the study group who continued using topical minoxidil have maintained the same response achieved by microneedling. Some of the patients who have followed up after the last session of microneedling, but stopped minoxidil application have not maintained the response that was achieved at the end of last session of microneedling.

DISCUSSION

Androgenetic alopecia (AGA) is the most frequent and progressive form of hair loss which worsens over time without treatment. As healthy hair is important for the young and attractive appearance of individual in this modern world, the consequences of AGA are predominantly psychological.[1] So, the main therapeutic objective is to maintain or induce hair growth activity.

Treatment of AGA is a challenge to the dermatologists. Various modalities of treatment have been proposed and used. No treatment modality is curative. Hair growth is achieved only on long-term treatment by various medical modalities of therapy and is not maintained after treatment discontinuation. The efficacy of any modality of treatment varies depending upon the age of the patient, grade of hair loss, compliance with treatment. Minoxidil and finasteride are the only FDA approved treatment modalities for AGA whose efficacy varies between 30% and 60%.[3] As per various studies, men with AGA using minoxidil monotherapy continue to go bald despite on therapy.

Dermal papillae plays a key role in the regulation of hair cycling and growth.[3] Various researches have demonstrated the underlying importance of Wnt proteins and wound growth factors in stimulating DP associated stem cells.[16] Microneedling and minoxidil also acts by various mechanisms in DP to induce hair re-growth.[25,26]

Based on studies in mice, Jeong *et al*. [25]and Kim *et al*.[26] suggested that micro needle roller could be useful tool to treat hair loss which is refractory to minoxidil therapy. Augmented effect of microneedling in promoting hair growth was demonstrated in men with AGA in Dhurat *et al*[3] study.

A total of 68 patients were recruited in the present study, 60 of whom completed the treatment duration of 12 weeks. Three patients in the study group and five patients in the control group were lost to follow-up. In similar study by Dhurat *et al*[3], ninety four out of 100 patients completed the 12 week study, of which 50 were treated with both microneedling and 5% minoxidil solution and 44 were treated with only 5% minoxidil solution.

We have included patients in the age range of 18-40 years whereas in the Dhurat *et al.* subjects were in the age group of 20 and 35 years. However the mean age of the population in study group was 27.53 years and in the control group was 24.56 years which were similar to findings in Dhurat *et al.* study (28.6 years). We have also modified our methodology by not making scalp shaving compulsory for the procedure, so that more patients can be included in the study. In the current study, patients had hair loss for a mean average duration of 4.1 years in study group and 2.6 years in control group, which was comparable to Dhurat *et al.* study (4.5 years).

In the present study, 17 subjects having grade III vertex and grade IV hair loss each in microneedling (study) group. Similarly, in the control group 20 had grade III vertex and 14 had grade IV hair loss where as in Dhurat *et al.* study 23 had grade III vertex and 27 had grade IV hair loss in microneedling group and 21 had grade III vertex and 23 had grade IV hair loss in the minoxidil group. Twenty one of our subjects had received some form of treatment in the past, whereas 20 had been treated with finasteride and minoxidil in the past without any improvement in Dhurat *et al*. study.

More than 50 % improvement was noted in 41 (82%) patients of microneedling group versus only 2 (4.5%) in the minoxidil group on patient self

assessment of hair growth at week 12 in the Dhurat *et al.* study, whereas only 4 (12.9%) of our study group subjects reported 50 % improvement. None of our controls reported more than 30 % improvement.

In the pilot study by Dhurat *et al.*, the mean increase in hair count at week 12 was significantly greater for the microneedling group compared to the minoxidil group (91.4 vs. 22.2 respectively, p = 0.039). In our study, the mean (±SD) increase in hair count at the end of 12 weeks, was 12.51(±6.82) in study group and 1.89 (±8.94) in control group which is significant (p<0.0001). Even though the change in hair count from baseline at week 12 is statistically significant in our study, it is very much less when compared with Dhurat *et al.* study. Comparison of mean increase in hair count with other study has been presented in table 9.

Table 9: Comparison of mean increase in hair count with other study

Study	**Microneedling group** **Increase in hair count**	**Minoxidil group** **Increase in hair count**	**p value**
Present study	12.5±6.82 (N=31)	1.89±8.94(N=29)	<0.0001*
Dhurat *et al* study	91.40±49.27(N=50)	22.20±19.34(N=44)	0.039*

Data presented as Mean±SD, *significant at p<0.05

In our study, 10 patients in the study group reported mild pain during microneedling procedure but it was tolerable. There was no significant adverse effect in both the groups of Dhurat *et al.*

From the above discussion it is evident that microneedling is an effective, safe and promising therapeutic modality for the treatment of AGA along with topical minoxidil 5% solution. However, the therapeutic response recorded in our study group of patients, though statistically superior to response in the control group, is not cosmetically significant when compared to Dhurat *et al.* study. Most plausible reasons for this finding may be due to difference in the procedures adopted for evaluating the increase in hair count and also by not making scalp shaving compulsory for the subjects. However, the sample size is small and short follow-up period is short in both the studies. Though the response achieved by microneedling in hair growth in our study subjects is significant, it was further preserved only on continuous use of minoxidil even after the study period. This finding is similar to conventional modalities of treatment where continuous long term treatment is required to maintain the response.

CONCLUSION

Progressive hair loss occurs in AGA patients which worsens over time if not treated. Treatment is required to prevent further baldness and also to promote new hair growth.

Various pathogenic factors are involved in the causation of AGA. Conventional modalities of treatment are not able to target all these factors. None of the medical therapeutic modalities available for AGA to date is completely curative. The efficacy of FDA approved minoxidil and finasteride for AGA varies between 30% and 60%. Long-term treatment is required to achieve the response and life-long treatment is necessary to maintain the response. This led to a large number of patients remaining unsatisfied with the current therapies. Microneedling has an advantage over conventional therapies as it targets multiple pathogenic factors of AGA. Hence it can show augmented response when combined with conventional modalities of treatment.

Out of 34 subjects in each group, only 4(12.9%) in the study group and none in the control group have reported 50 % improvement in hair growth on patient self assessment scale. The mean increase in hair count at week 12 was significantly greater for the subjects in the microneedling group compared to the minoxidil only group (12.5 vs.1.25 respectively, $p < 0.0001$). However, the response achieved in microneedling subjects is maintained further only if there is continuous application of minoxidil.

No therapy related side effects were noted in the control group. Subjects in the study group have reported mild pain during and after microneedling procedure which is tolerable.

The results of this study did not establish ‘microneedling combined with minoxdil’ as a unique therapeutic modality for male AGA. However the study had a small sample size and limited follow-up of the patients. However, the total number and frequency of sessions and long-term sustainability of response of microneedling need to be evaluated within a larger population.

SUMMARY

A hospital based prospective and single observer blinded study to determine the efficacy of combination of topical minoxidil and microneedling versus minoxidil alone in male AGA was conducted during the period of November 2015 to May 2017. Male patients of 18 - 40 years age group with AGA grade III and IV were the study subjects. 34 patients each were included in study and control groups. Patients in the 'study' group were offered 'microneedling' treatment on scalp along with 1 ml of 5% minoxidil solution applied twice daily whereas control group subjects were given only 5% minoxidil solution 1ml for twice daily application for a period of 12 weeks. Response to treatment in the form of increase in hair count and patient's self assessment of hair growth were evaluated at the end of 12 weeks.

Following are the salient observations of the study:

- The mean age (± SD) of the subjects in study and the control group was 27.53 (± 5.142) years and 24.56 (± 3.386) years respectively.
- The mean age (± SD) of onset of hair loss of the subjects in study and the control groups was 23.56 (± 3.295) years and 21.71 (± 3.398) years respectively.
- History of receiving treatment in the past was present in 21(30.8%) of 68 patients with androgenetic alopecia in both the groups.
- Most prevalent type of AGA was grade IV in both the groups.
- In study group, maximum improvement in hair growth reported was 50 %, observed in 12.9 % of patient whereas in the control group, 30 % improvement was reported in 6.9% of patients.

- The mean increase in hair count at week 12 was 12.82 Vs. 1.89 for study and control groups respectively.
- Mild pain was reported during the microneedling procedure.
- Only the patients, who continued topical minoxidil application have maintained the same response achieved at the end of last session of microneedling.

BIBLIOGRAPHY

1. Seghal VN, Kak R, Aggarwal A,Srivastava A,Rajput P. Male pattern androgenic alopecia in an Indian context: a perspective study. J Eur Acad Dermatol Venereol 2007; 21:473-479.

2. Dhurat R, Mathapathi S. Reponse to microneedling treatment in men with androgenetic alopecia who failed to respond to conventional therapy. Indian J Dermatol 2015; 60:260-263.

3. Dhurat R, Sukesh MS, Avhad G, Dandale A, Pal A, Pund P. A randomized evaluator blinded study of effect of microneedling in androgenetic alopecia: A pilot study. Int J Trichology 2013; 5:6-11.

4. Rahnayake D, Sinclair R. Male Androgenetic Alopecia. In: De Groot LJ, Beck-Peccoz P, Chrousos G, et al., editors. Endotext [Internet]. South Dartmouth (MA) :MDText.com, Inc.; 2000-.Available from: http://www.ncbi.nlm.nih.gov/books/NBK278957/.

5. Kaliyadan F, Nambiar A, Vijayaraghavan S. Androgenetic alopecia: An update. Indian J Dermatol Venereol Leprol 2013; 79:613-25.

6. Dhurat R, Sukesh MS. Hair and scalp disorders. In: Sacchidanand S, Oberai C, Inamadar AC, editors. IADVL Text Book of Dermatology. 4th edn. Mumbai: Bhalani Publishing Home; 2015.p.1489-1501.

7. Randall VA, Thorton MS, Hamada K, Messenger AG. Mechanisms of androgen action in cultured dermal papilla cells derived from human hair follicles with varying response to androgens in vivo. J. Invest. Dermatol 1992; 98: 865-915.

8. Kwack MH, Sung YK, Chung EJ, Im SU, Ahn JS, Kim MK, Kim JC. Dihydrotestosterone-inducible dickkopf 1 from balding dermal papilla cells causes apoptosis in follicular keratinocytes. J. Invest. Dermatol. 2008; 128 : 262-269.

9. Kwack MH, Kang BM, Kim MK, Kim JC, Sung YK. Minoxidil activates β-catenin pathway in human dermal papilla cells: a possible explanation for its anagen prolongation effect. J Derm Sci. 2011; 62 : 154-9.

10. Gupta M, Mysore V. Classification of Patterned Hair Loss: A Review. J Cutan Aesthet Surg 2016; 9: 3-12.

11. Messenger AG, Rundegren J. Minoxidil: mechanisms of action on hair growth. Br J Dermatol. 2004; 150:186-94.

12. Fang JY, Shen FM, Huang CT. Squarticles as a nanocarrier for targeting minoxidil to hair follicles and dermal papilla cells. J Derm Sci. 2016; 84:e59.

13. Shanshanwal SJ, Dhurat RS. Superiority of dutasteride over finasteride in hair regrowth and reversal of miniaturization in men with androgenetic alopecia: A randomized controlled open-label, evaluator-blinded study. Indian J Dermatol Venereol Leprol 2017; 83:47-54.

14. Wolf R, Matz H, Zalish M, Pollack A, Orion E. Prostaglandin analogs for hair growth: great expectations. Dermatol Online J. 2003; 9:7.

15. Blume-Peytavi U, Lonnfors S, Hillmann K, Bartels NG. A randomized double-blind placebo-controlled pilot study to assess the efficacy of a 24-week topical treatment by latanoprost 0.1% on hair growth and

pigmentation in healthy volunteers with androgenetic alopecia. J Am Acad Dermatol 2012;66:794–800.

16. Inui S, Itami S. Reversal of androgenetic alopecia by topical ketoconazole: relevance of anti -androgenic activity. J Dermatol Sci 2007; 45:66-68.

17. Perez HBS. Ketoconazole as an adjunct to finasteride in the treatment of androgenetic alopecia in men. Med Hypotheses 2004; 62:112-115.

18. Zimber MP, Ziering C, Zeigler F, Hubka MDC, Jonathan N, Mansbridge JN, *et al* . Hair regrowth following a Wnt - and follistatin containing treatment : safety and efficacy in a first-in-man phase1 clinical trial . J Drugs Dermatol 2011;10:1308-1312.

19. Navarro MR, Asín M, Martínez MA, Martínez AM, Molina C, Moscoso L, Pino A, Orive G, Anitua E. Management of androgenetic alopecia: a comparative clinical study between plasma rich in growth factors and topical minoxidil. Eur J Plast Surg 2016; 39:173-180.

20. Shiell RC. A review of modern surgical hair restoration techniques. J Cutan Aesthet Surg 2008;1:12-16.

21. Rose PT. The latest innovations in hair transplantation. Facial Plast Surg. 2011; 27:366-377.

22. Avram MR, Leonard Jr RT, Epstein ES, Williams JL, Bauman AJ. The current role of laser/light sources in the treatment of male and female pattern hair loss. J Cosmet Laser Ther 2007; 9: 27-28.

23. Pyo HK, Yoo HG, Won CH, Lee SH, Kang YJ, Eun HC, Cho KH, Kim KH. The effect of tripeptide-copper complex on human hair growth in vitro. Archives of pharmacal research. 2007; 30: 834-839.

24. Toyoshima KE, Asakawa K, Ishibashi N, Toki H, Ogawa M, Hasegawa T, *et al.* Fully functional hair follicle regeneration through the rearrangement of stem cells and their niches. Nat Commun 2012; 3:784.

25. Sonthalia S, Daulatabad D, Tosti. Hair Restoration in Androgenetic Alopecia: Looking Beyond Minoxidil, Finasteride and Hair Transplantation. J Cosmo Trichol 2016;2:1.

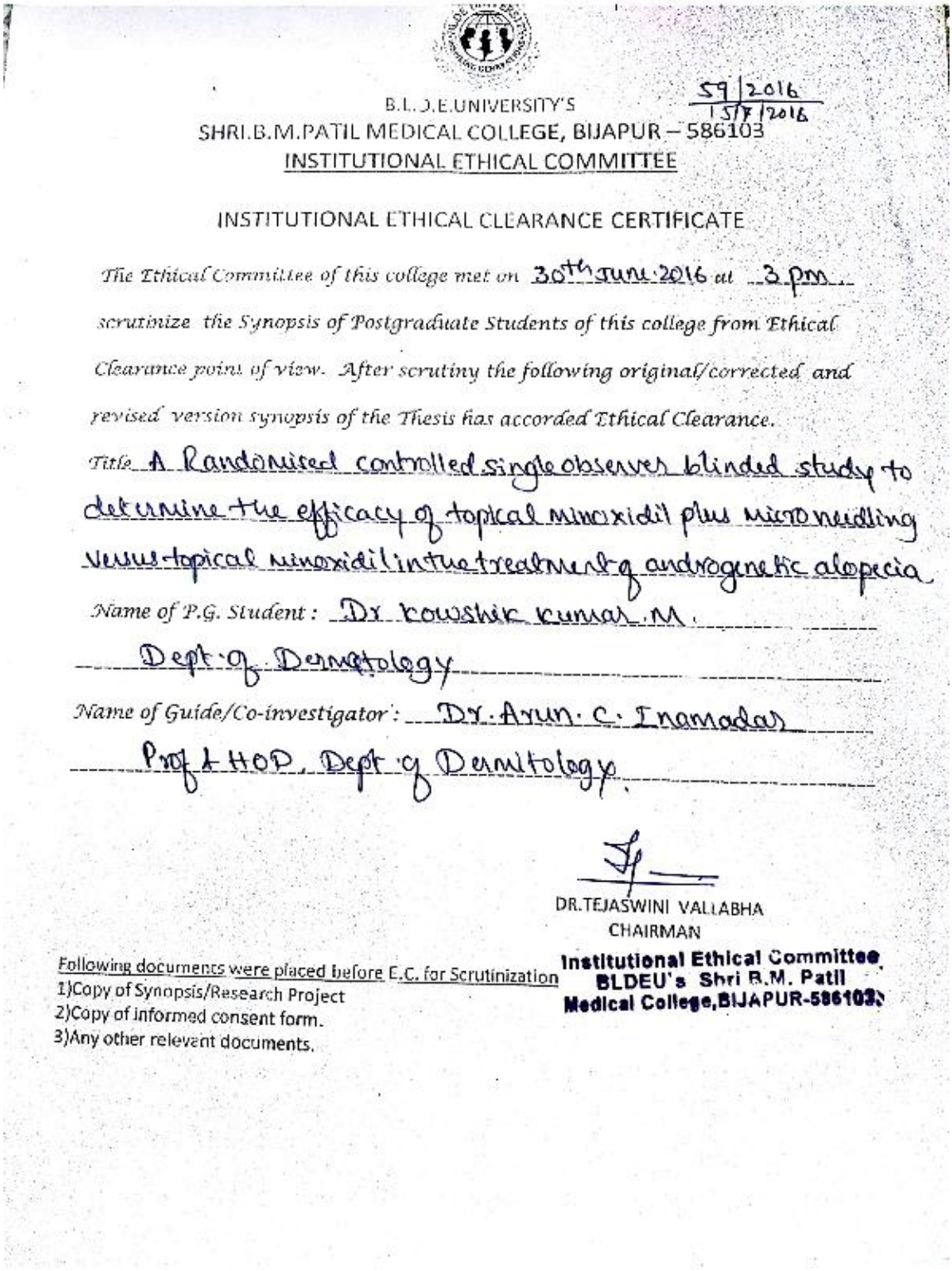
26. Singh A, Yadav S. Microneedling: Advances and widening horizons. Indian Dermatol Online J 2016;7:244-254.

27. Jeong K, Lee YJ, Kim JE, Park YM, Kim BJ, Kang H. Repeated microneedle stimulation induce the enhanced expression of hair-growth-related genes. Int J Trichology 2012;4:117.

28. Kim BJ, Lim YY, Kim HM, Lee YW, Won CH, Huh CH, *et al*. Hair follicle regeneration in mice after wounding by microneedle roller. Int J Trichology 2012;4:117.

ANNEXURES

ETHICAL CLEARANCE CERTIFICATE



B.L.D.E.UNIVERSITY'S

59/2016
15/7/2016

SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR – 586103

INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 30th June 2016 at 3 pm *scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected and revised version synopsis of the Thesis has accorded Ethical Clearance.*

Title A Randomised controlled single observer blinded study to determine the efficacy of topical minoxidil plus microneedling versus topical minoxidil in the treatment of androgenetic alopecia

Name of P.G. Student : Dr kowshik kumar M.
Dept of Dermatology

Name of Guide/Co-investigator : Dr. Arun C Inamadar
Prof & HOD, Dept of Dermitology

DR.TEJASWINI VALLABHA
CHAIRMAN

Institutional Ethical Committee
BLDEU's Shri B.M. Patil
Medical College,BIJAPUR-586103

Following documents were placed before E.C. for Scrutinization
1)Copy of Synopsis/Research Project
2)Copy of informed consent form.
3)Any other relevent documents.

Scanned by CamScanner

B.L.D.E.U's SHRI B M PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR-586103

RESEARCH INFORMED CONSENT FORM

TITLE OF THE PROJECT : - A RANDOMISED CONTROLLED SINGLE OBSERVER BLINDED STUDY TO DETERMINE THE EFFICACY OF TOPICAL MINOXIDIL PLUS MICRONEEDLING VERSUS TOPICAL MINOXIDIL IN THE TREATMENT OF ANDROGENETIC ALOPECIA.

PG GUIDE : - DR ARUN C INAMADAR

PG STUDENT : - DR KOWSHIK KUMAR M

PURPOSE OF RESEARCH:-

I have been informed that this project will be studied to measure the psychological impact of vitiligo.

BENEFITS:-

I understand that my participation in this study will help the investigator to study the efficacy of microneedling in treatment of androgenetic alopecia which helps in better assessment of patients' perception of their disease as well as effectiveness of therapy.

PROCEDURE:-

I understand that relevant history will be taken and I will undergo detailed clinical examination after which necessary investigations will be done whenever required.

CONFIDENTIALITY:-

I understand that medical information produced by this study will become a part of my hospital records and will be subjected to the confidentiality and privacy regulation of the said hospital. Information of a sensitive personal nature will not be a part of the medical records, but will be stored in the investigator's research file.

If the data are used for publication in the medical literature or for teaching purposes no names will be used and other identifiers such as photographs and audio or videotapes will be used only with my special written permission. I understand I may see the photographs, videotapes and hear the audiotapes before giving this permission.

REFUSAL OR WITHDRAWAL OF PARTICIPATION:-

I understand that my participation is voluntary and I may refuse to participate or may withdraw consent and discontinue participation in this study at any time without prejudice. I also understand that Dr Kowshik Kumar M may terminate my participation in this study at any time after she has explained the reasons for doing so and has helped arrange for my continued care by my own physician, if this is appropriate.

INJURY STATEMENT:-

I understand that in the unlikely event of injury to me resulting directly from my participation in this study and if such injury were reported promptly, then medical treatment will be available to me, but no further compensation will be provided. I understand that by my agreement for my participation in this study, I am not waiving any of my legal rights.

I have explained to (patient's / relevant guardian's name) the purpose of the research, the procedures required, and the possible risks and benefits to the best of my ability in patient's own language.I confirm that …….……(Name of the PG guide / chief researcher) has explained to me the research, the study procedures that I undergo and the possible risks and discomforts as well as benefits that I may experience. I have read and I understand this consent form. Therefore, I agree to give my consent for my participation as a subject in this research project.

_____ _____

Participant / guardian Date

_____ _____

Witness to signature Date

PROFORMA

SCHEME OF CASE TAKING

B.L.D.E.U'S SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR.

Department of Dermatology, Venereology and Leprosy

Name: **SL NO:**

Age: **Date:**

Sex: **IP NO/ OP NO:**

Occupation:

Address:

1. Chief complaints:

2. Presenting features :

- **Age of onset of hair loss:**
- **Duration of hair loss:**
- **associated systemic disorder:**

3. Any previous treatment received:

4. family history:

5. Past history:

History of treatment with androgenic medications:

History of bleeding disorder:

History of surgery/stress:

Any other dermatologic condition:

Any anti-coagulant medication:

History of keloidal tendency:

6. <u>General Physical Examination</u>:

Weight:	**BP:**	**Pulse rate:**
Pallor:	**Cyanosis:**	**Icterus:**
Clubbing:	**Lymphadenopathy:**	**Edema:**

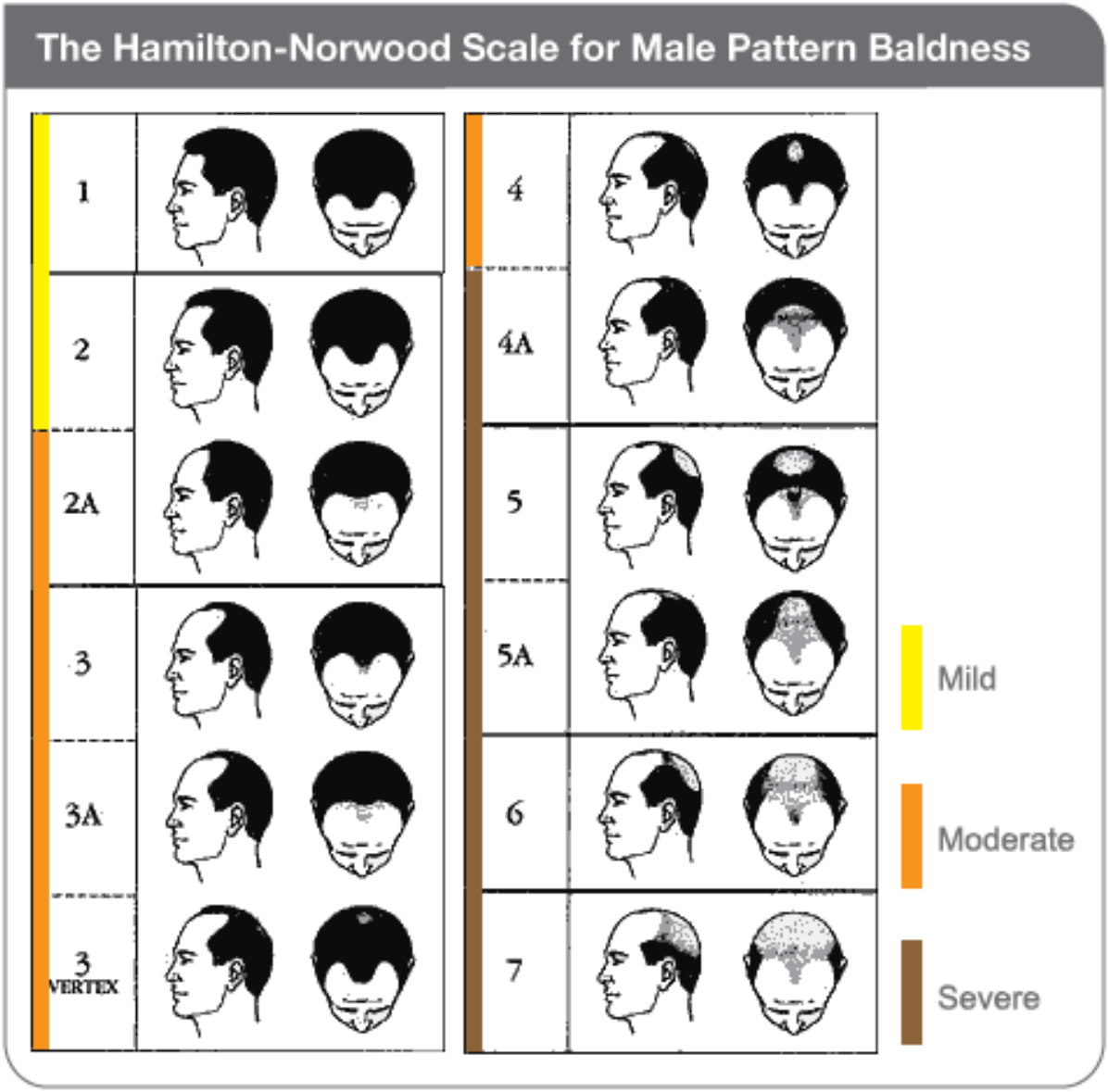
7. <u>Cutaneous examination:</u>

Scalp Site: infection?

koebner phenomenon: present/ absent

Hair: AGA grade

I / II / III/ IIIv / IV / V / VI / VII / IIa / IIIa / IV a / Va



Measurements of the test area on vertex to be used for hair count:

-From glabella (a) :

-From occiput (b) :

-From right ear helix tip (c) :

-From left ear helix tip (d) :

8. Systemic Examination

Cardiovascular system :

Respiratory system :

Central nervous system :

Abdominal examination :

9. Diagnosis:

B.L.D.E.U'S SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND

RESEARCH CENTRE, VIJAYAPUR.

Department of Dermatology, Venereology and Leprosy.

Patient self Assessment Scale of hair growth

Visual Analogue Scale