"PLATELET RICH PLASMA VERSUS INJECTABLE PLATELET RICH FIBRIN IN THE TREATMENT OF MALE PATTERN BALDNESS-A SPLIT SCALP INTERVENTIONAL STUDY."

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LIST OF ABBREVIATIONS USED

Sl. No.	Abbreviation	Expansion
1.	AGA	Androgenetic alopecia
2.	AR	Androgen receptor
3.	DHEA-S	Dihydrotestosterone-sulfatase
4.	DHT	Dihydrotestosterone
5.	DP	Dermal papilla
6.	EGF	Epidermal growth factor
7.	FDA	Food and Drug Administration
8.	FGF	Fibroblast growth factor
9.	GF	Growth factor
10.	GFR	Growth factor receptor
11.	IADVL	Indian association of Dermatologists, Venereologists and Leprologists
12.	IGF-1	Insulin-like growth factor 1
13.	I-PRF	Injectable platelet-rich fibrin
14.	IRS	Inner root sheath
15.	KGF	Keratinocyte growth factor
16.	MMP	Matrix metalloproteinases
17.	MPHL	Male pattern hair loss
18.	ORS	Outer root sheath
19.	PDGF	Platelet-derived growth factor
20.	PPP	Platelet-poor plasma
21.	PRP	Platelet-rich plasma
22.	RBC	Red blood cells
23.	SD	Standard deviation
24.	SHBG	Sex-hormone-binding globulin
25.	Shh	Sonic hedgehog
26.	TE	Telogen effluvium
27.	TGF-□	Transforming growth factor-beta
28.	TNF-□	Tumor necrosis factor alfa
29.	VEGF	Vascular endothelial growth factor
30.	Wnt	Wingless
31.	µL	Microliter

ABSTRACT

Introduction: Androgenetic alopecia (AGA) is a non-scarring type of hair loss caused by genetic predisposition and hormones. This condition, impacting individuals of both genders, involves a gradual decrease in the size of hair follicles, exhibiting a distinct pattern of distribution., it affects both men and women. About 50–60% of men start to become bald by the time they are 70 years old. This condition can have a significant psychological impact on affected individuals. Norwood-Hamilton's scale is used for grading. The diagnosis is mainly based on clinical evaluation. While histopathology is the preferred diagnostic method, it requires multiple biopsies and can lead to disfigurement. "Trichoscopy" is the term used for the dermoscopic examination of hair units. It is a non-invasive and rapid tool that allows for the visualization of various factors such as the hair diameter, hair density, number of hairs per unit follicle, kenogen follicles, inter-follicular distance, perifollicular epidermis, and hair diameter diversity under higher magnification. PRP and I-PRF are autologous biomaterials that are fractions of blood plasma highly enriched with platelets, and growth factors required for hair growth.

Objective: To know the effectiveness of platelet rich plasma versus injectable platelet rich fibrin in androgenetic alopecia.

Materials and method: This was a one-year hospital-based split scalp interventional study that included 36 patients diagnosed with Androgenetic Alopecia (AGA) and classified according to Norwood-Hamilton's hair loss classification. PRP injections are administered to the left side of the scalp while I-PRF injections on the right. They underwent 4 sessions at an interval of 4 weeks over 4 months. Trichoscopic examination was performed using a hand-held digital microscope connected to a laptop computer as a portable trichoscope: Dino-Lite AM4113ZT USB Digital Microscope, Magnification of 200X, 1280 x 1024 pixels, with relevant photographs. ImageJ software was used to measure the hair parameters from the photographs.

Results: After 4 sessions of PRP, 52.8% of cases had 0 to 25% improvement, 25% of cases had 26 to 50% improvement, 13.90% of cases had 51 to 75% improvement, and 8.3% of cases had 76 to 100% improvement. While in I-PRF, 52.80% of cases had 0 to 25% improvement, 27.80% of cases had 26 to

50 % improvement, 8.30% of cases had 51 to 75% improvement, and 11.10% of cases had 76 to 100% improvement when compared with baseline, at 4 months. The mean age range of study participants was 31.69 years, and 5.47 years is mean duration of AGA.

Conclusions: AGA is a complex disorder, and a combination of therapies should be used. Specific trichoscopy features can assist in diagnosing the condition and reduce the need for biopsies. Extending the treatment sessions can lead to improved results. Although using PRF for hair regeneration is relatively new, further research with lengthier follow-up periods and larger sample sizes is necessary to understand its effects. Autologous PRP and I-PRF have shown positive effects on AGA with minimal side effects.

Key words: Alopecia, Injectable – platelet-rich fibrin, Platelet-rich plasma, Growth factors, Hair parameters, Trichoscopy.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF CHARTS

LIST OF FIGURES

5b	3.2% sodium citrate vacutainers	**79**
5c	Insulin syringe	**79**

INTRODUCTION

In men, AGA is recognized as the predominant type of hair loss, marked by a gradual decrease in the size in hair follicles and a shortened growth phase in those genetically predisposed[1]. This condition can significantly affect the quality of life for those affected, regardless of their age or gender. Hair follicles gradually become smaller, vellus hair replace terminal hair, leading to a characteristic pattern of baldness on the scalp. Androgen-dependent hair loss typically begins after puberty and becomes severe as people age.

At times "female pattern hair loss" & "male pattern hair loss" are as well used to elucidate the variations in hair loss patterns between men and women, though women may exhibit the "male" pattern.

Under appropriate magnification, one can see that human hair grows from the scalp in clusters referred to as follicular units. According to histological features, these structures are made up of 1, 2, 3, and in rare cases 4 or 5 hairs that collectively form a unique group that is encircled by an adventitial collagen band.

There are three phases of an average hair cycle: i) an active growth phase (anagen), which would last about two to six years, ii) a momentary stage of regression (catagen), which takes two to three weeks, and iii) a resting phase (telogen), which would sustain anywhere from about two to three months. Anagen phase's time span shortens while that of telogen phase duration lengthens with each hair cycle passage. As the hair length is mostly set on by the length of the phase of anagen, the maximal length of a newly formed hair in the anagen phase is shorter compared to its precursor. When the anagen phase finally becomes so short that the developing hair does not reach the skin's surface, a pore is the only sign that a follicle is still active.

The dermal papillae which is mesenchyme-derived, preserves the growth of hair, in addition to the multipotent epithelial stem cells in the bulge that promote differentiation and proliferation.

An essential element in the pathophysiology of AGA is undesired androgen metabolism at the hair follicle. The most important element in MPHL is elevated activity of the 5-alpha-reductase (5AR) enzyme, which metabolizes circulating testicular testosterone into DHT in genetically predisposed hair follicles of the temporal and vertex areas.

The factors that sustain anagen, such as IGF-1, FGF, PDGF, and VEGF, are reduced in AGA, whereas ones that promote apoptosis, such as Tumor Necrosis Factor α (TNF α), Interleukin 1α (IL -1α) & Transforming Growth Factor β1 (TGF β1), are increased. These alterations may be brought about by androgenic hormones stimulating the androgen receptors in the DP.

AGA is the most prevalent type of alopecia, which is brought about by androgenic shrinkage of the HF and is marked by restrained hair loss that increases gradually with age. AGA is just one of several disorders that can cause hair loss. Treatment for alopecia can be challenging, particularly when it's advanced—as in cases of Norwood-Hamilton Type VI and VII.

Trichoscopy is an alternative non-invasive, rapid tool that allows visualization of the perifollicular epidermis, number of hair follicles per unit, empty hair follicle, inter-follicular distance, hair density, hair shaft diameter diversity at high magnification.

PRP, or platelet-rich plasma, is a first-generation platelet concentrate used in dermatology that has been used for a long time with varying degrees of success in treating a variety of skin and cosmetic issues.

Anticoagulants have raised questions because of the possibility of hypersensitivity when used with PRP. This worry is resolved by injectable PRF, which is a totally autologous biomaterial with almost little risk of hypersensitive reaction and doesn't require the use of an anticoagulant.

The PRP itself has experienced a generational shift. The growth factors (GFs) in platelet concentrate, or PRP, are short-lived, lasting anywhere from a few minutes to an hour. Platelet-rich fibrin (PRF), the template for second-generation concentrates, capitalizes on the short half-life of platelets, which is seven to ten days. Fibrin scaffolding facilitates the use of this characteristic by releasing GFs over time. And to create this scaffolding, a single-spin technique in specialized tubes is used rather than an anticoagulant.

In fact, PRF is a novel idea in platelet concentration that gathers platelets. As opposed to traditional PRF, injectable-PRF (i-PRF) and Advanced-PRF^{TM} (A-PRF^{TM}) are based on the idea that a low centrifugation speed produces maximal outcomes as well as a markedly increased concentration of growth factors, platelets, and leukocytes—improving the process of regeneration. Similar to PRP, PRF is widely used in the disciplines of orthopedics, dermatology, burn wound care, treatment for diabetic foot conditions, maxillofacial & dental surgery, as well as periodontal treatments, plastic surgery, and anywhere else regeneration is needed.

Hair growth is aided by some medications, hair transplant therapy, and PRP injections. PRP has demonstrated remarkable efficacy in the hair loss control. Hair growth would be helped by the growth factros released by activated platelets in platelet-rich plasma (PRP); PRF is an enhanced form of PRP.

“The Indian Association of Dermatologists, Venereologists & Leprologists” (IADVL) expert group recommends using a manual double-spin technique to prepare PRP for

AGA. For AGA, it is advised to have three to five PRP sessions, with a one-month interval between each session.

Trichoscopy was used to examine AGA cases, and the significance of particular traits was reviewed to improve non-invasive distinction, aid in clinical diagnosis, and reduce the number of cases requiring biopsy.

In PRP and I-PRF can play a leading role or be used as a compliment for the treatment of hair loss. There is a escalating requirement for better treatment or procedures that would restore a patient's self-esteem and satisfy their cosmetic concerns.

AIMS AND OBJECTIVES

- To know the effectiveness of PRP versus I-PRF in male pattern baldness

REVIEW OF LITERATURE

History

Anitua made the first attempt to categorize PRP in 1999, based only on concentration of crude platelets. Sánchez et al.'s 2007 study expanded on this by classifying blood dependent on the concentrations of white and red blood cells. The classification that we are so familiar with P-PRP and P-PRF which are leukocyte-poor or pure plasma and fibrin and L-PRP and L-PRF which are Leukocyte-rich plasma and fibrin were supplied by Dohan Ehrnefest et al in 2009.

Epidemiology

Hamilton approximated that between 30% to 50% of men experienced MAA by the time they reached 50 years old. Numerous research studies have shown variations in occurrence and distribution of loss of hair in MAA relied on both racial background and age.

Caucasian males reportedly have a higher incidence and severity of MAA than men of other ethnicities. It has been displayed that compared to Mongolian populations, Caucasian populations experience complex degrees of alopecia, more frequently and at a young age. Compared to Caucasians, Japanese people experience the onset of MAA ten years later. Compared to Caucasians, African-American Black men are more probable to have less extensive and late-onset of baldness & preservation of their frontal hair lines.

Hair Cycle Anatomy

The two primary structural components of hair are the hair shaft, which is a completely keratinized, inanimate portion located on top of the skin's surface, and beneath the skin

lies the follicle, which is the living portion. The APM (also, arrector pili muscle) is found in the middle of the dermo-epidermal junction and the hair bulge region. Sebaceous and apocrine glands emerge into the follicle above a particular point where the APM inserts.

Thee cuticle, cortex, and medulla comprise 3 layers forming hair shaft. Square-shaped and flat cuticle cells cling firmly to the cells of the cortex in the proximal direction. The cuticle serves as a defense against chemical and physical harm. Cuticle cell motions at the periphery cause the distal free edge to point upward leading to considerable overlap. These are crucial imbrications. By interacting with the cuticle cells of the inner root sheath, they facilitate the follicular anchoring of the growing hair. It is simpler to remove debris and desquamated cells from the scalp owing to these imbricated surfaces.

The follicle is considered the fundamental building block for the development of hair. It is physically split into 2 parts: thee bottom portion, that comprises of the suprabulbar area & the hair bulb, and next, the upper part, which is composed of the infundibulum and isthmus. As the lower follicle consistently regenerates, the follicle on the top stays constant.

Thee hair follicle’s top most part, known as the infundibulum, runs from surface of skin to the sebaceous gland's duct. The structure is funnel-shaped and comprises sebum formed by sebaceous glands. The top region, known as the acroinfundibulum, undergoes keratinization of the epithelium through the creation of stratum granulosum and also stratum corneum.

The isthmus present centre of the insertion of the sebaceous gland and the APM. This is the area where keratinization starts, commonly known as "trichilemmal keratinization," without the presence of granular layer. The area of the bulge on the isthmus is site to the stem cells found in hair follicles. The offspring of multipotent bulk cells produce the new

lower anagen hair follicle. They go downhill as they migrate. Hair Shaft and Inner Root Shaeth would be produced by terminal differentiation in the hair bulb matrix . They also travel distally to produce sebaceous glands and proliferate in response to damage. Thee supra-bulbar area, located over the bulb of the hair. It is composed of 3 layers viz., IRS, hair shaft, & ORS.

The supra-bulbar area, present beneath the isthmus and over the bulb of the hair in the follicle. From innermost to outermost, it is composed of 3 layers viz., Inner Root Sheath, Hair Shaft & the Outter Root Sheath.

The cells of outter root sheath undergo significant alterations along the course, extending from the epidermis which would be at the infundibulum to the hair bulb. At infundibulum, the ORS mimics the epidermis, but at the isthmus level, cells of ORS start to keratinize in the way trichilemmal. The hair bulge region is formed by keratinocytes in the ORS near the base of the isthmus. It is composed of one layer of cuboidal cells at the lower end of the hair bulb, which at the top goes on to become multilayered. Companion layer, a one cell layer that sits between the ORS and IRS in some follicles, is present. It is believed that companion layer cells move distally with the IRS towards the isthmus area, where between the IRS and the ORS , the plane of slippage gets created. They also exhibit many intercellular connections to the IRS. Merkel cells, Langerhans cells, and melanocytes are additional cells found in the ORS of the follicle. These cells participate in the follicle's ability to operate as a organ of sensory and immunologic sentinel of the skin.

The three layers that comprise the IRS are the cuticle layer, the Huxley layer, & the Henle's layer. Cuticle, which is the innermost layer of IRS, is made up of cells that interlock with hair cuticle cells. The hair shaft is firmly anchored to the hair follicle by

this link. It is believed that the IRS controls the final form of hair shaft as it would harden before the presumed hair inside of it. All three IRS layers experience sudden keratinization. The outermost layer, the Henle's layer, is where keratinization initially manifests. At what is referred to as Adamson's fringe, the Huxley layer keratinizes over the Henle's layer. The dermal papilla introverts the hair bulb at its base, controlling the proliferation and differentiation of matrix cells and figuring out the hair shaft's size by the condensation of mesenchymal cells. AGA is characterized by follicular miniaturization brought on by dysfunctional DP.

The four phases of a typical hair cycle are exogen (shedding), telogen (rest), anagen (growth), and catagen (regression). The length of each phase varies according to the individual's age, nutritional and hormonal health, and hair location.

Anagen: the follicle grows and returns to its original size, while hair fibers are produced. The anagen stage consists of six portions - anagen I–VI. About 85–90% of scalp hairs are in this phase, which can last 6–8 years. Hair stem cells multiply, enclosing the dermal papilla, and hair shaft and IRS begin to form. Pigmentation and hair shaft synthesis occur. Anagen duration determines hair length. Regulatory proteins like BMPs, sonic hedgehog, and WNT proteins are involved. IGF-1, FGF-7, HGF, and VEGF help maintain anagen[1].

Catagen follows anagen, marking a controlled involution phase lasting about two weeks. During this phase, matrix cell activity decreases, leading to keratinisation of proximal hair shaft into a club hair, while the distal follicle regresses through apoptosis. Melanogenesis ceases within hair bulb. Catagen involves apoptosis in follicular keratinocytes, halting pigment production and causing dermal papillae condensation. Follicle decreases to epithelial strand, elongating towards the AP muscle insertion. As the club hair keratinizes, shortening of epithelial strands begins, followed by papilla

condensation. Eventually, a another hair germ forms under the club. FGF5 triggers catagen, along with other factors like TGF-β1, NT-3,IL-1b, NT-4, BMP2/4 & TNF-α.

Telogen is the phase between follicular regression and the successive phase of anagen, lasting for 2 to 3 months. About 10% to 15% hair is in this period. During telogen, the shafts of hair become club hair and are eventually shed. Telogen is a key phase influenced by various factors like retinoids, androgens, prolactin, ACTH and thyroid hormones. Estrogen receptors are mainly found in telogen papilla fibroblasts. The growth factor, BMP-4, suppresses follicular growth and differentiation during telogen.

Kenogen, originating from Greek for "empty," denotes the lag phase or empty follicle phenomenon. Studied via phototrichogram, it reveals follicles remaining empty, aligning with telogen hair shedding and new anagen hair emergence (teloptosis). During telogen, epithelial remnants undergo biochemical activity and some proliferation, suggesting kenogen as the true resting phase.

Exogen: period of shedding

Pathophysiology

Androgenetic alopecia, a genetically determined condition, progresses as terminal hairs gradually transform into indeterminate and then vellus hairs. Those affected typically experience a reduction in the terminal to vellus hair ratio, usually around 4:1. As follicles undergo miniaturization, fibrous tracts persist. Patients typically exhibit a recognizable pattern of hair loss with this disorder.

AGA involves the shedding of big terminal follicles, which are substituted by vellus hair which are generally small. It predominantly affects 3 scalp portions: the temples, vertex scalps, and mid frontal scalp, each showing a distinct pattern of hair loss. Bitemporal hair

loss starts at the front hairline and progresses backward, while vertex scalp loss begins at the center and spreads outward. Mid frontal scalp loss resembles a Christmas tree pattern due to follicle miniaturization. However, these portions are not uniformly affected, causing differences in hair loss patterns among individuals, while some experiencing additional frontal balding and others more crown balding.

Pathway Signalling in Androgenetic Alopecia

In areas of baldness, researchers observed increased levels of prostaglandin synthase (PGDS) and concluded that the resulting product, prostaglandin D2 (PGD2), hinders hair growth by triggering an early catagen phase.

Elevated androgen levels cause a decrease in gene expression within the Notch pathway through negative feedback, resulting in hair follicle miniaturization and increased output of the AR gene. Androgens attach onto the androgen receptor, which exhibits a strong affinity for β-catenin[2], consequently suppressing the Wnt signaling pathway.

The functions of hormones, growth factors, and receptors on hair.

Different hormones such as GH, thyroid hormones, insulin, cortisol, estrogens, and prolactin interact with a range of growth factors and cellular receptors to influence the growth of hair.

Growth Hormone

GH, upon binding to GHR, has direct and indirect impacts mediated by IGF production. Immunohistochemistry has revealed GH presence in both hair follicles and sebaceous

gland acini, promoting sebocyte differentiation. Additionally, it enhances the influence of DHT on sebocyte differentiation.

Cortisol

Hydrocortisone has been found to stimulate sebocyte proliferation in manner dependent on dose during in vitro studies of human sebocyte. Cortisol would also increases IGF-I's proliferative impact at low levels.

Insulin and Insulin-Like Growth Factor

Insulin, sharing about 50% amino acid similarity with IGFs, functions as an IGF substitute. In vitro studies indicate that the non-presence of insulin causes the hair follicles to premature entry into a catagen-like state. Moreover, high doses of insulin have been known to promote sebocyte proliferation in vitro.

Estrogen: Extends thee growth phase of hair on the scalp by delaying the transition from anagen to telogen. It maximises the percentage of scalp follicles remaining in the anagen stage during late pregnancy. Postpartum telogen effluvium is have been thought to occur from rapid decline in estrogen levels at delivery, causing many hair follicles to shift into the telogen phase.

Thyroid Hormones: Both hypo- and hyperthyroidism accelerate the initiation of the follicular cycle but hinder the shedding of club hair, thus slowing hair growth. Immunohistochemistry has identified receptors of thyroid hormone in ORS, sebaceous gland and dermal papilla. In hypothyroidism, scalp hair lack luster and fragile, with diffuse alopecia marked by a higher proportion of follicles in the telogen phase.

Parathyroid hormone and parathyroid hormone-related protein: Research has shown that PTHrP and its mRNA are present in various tissues, organs containing rapidly dividing

cells like bones, kidneys, placenta, HFs & skin. Receptors for PTHrP and PTH inside dermal sheath[2] and papilla during hair development. Stimulating these receptors controls the transition to catagen from anagen. Consequently, scientists have explored PTH antagonists as potential targets for developing topical drugs to promote hair growth in vivo.

Vitamin D receptors (VDR) are found in epidermal keratinocytes, the ORS keratinocytes, and mesodermal DP cells within hair follicles. Their presence is essential for the normal cycling & a deficiency can disrupt keratinocyte division and regular postnatal hair follicle cycle. Furthermore, 1α hydroxylase, synthesizes 1,25(OH)2D3, 25-hydroxyvitamin D, is indicated in epidermis's basal layer and the matrix of HFs in the dermis. This indicates that keratinocytes within hair follicles both produce and respond to their own 1,25(OH)2D3.

Dynamics of hair cycle and AGA: Hair cycle exhibits inherent rhythmic behavior influenced by factors, both local and systemic. An asynchronous cycle remodelling of hair, results in variations in anagen duration and final length across different body regions. Some growth factors like as IGF-1, HGF, KGF & VEGF stimulates anagen phase, while TGF-beta, IL 1-alpha, and TNF-alpha promote catagen[3].

Each cycle in AGA causes the phase of anlagen to gradually shorten while the telogen phase's length either stays the same or may even lengthen. This leads to a decrease in ratio of anagen to telogen. Individuals experiencing hair loss often notice periods of increased shedding, particularly during washing/combing, owning to higher number of hair follicles in telogen stage. Consequently, when each hair cycle becomes shorter, the extent of evry hair shaft decreases. Gradually, the phase of anagen turns out to be so brief that developing hair does not succeed to reach the surface of skin, resulting in empty

follicular pores. In MAA, the kenogen phase, or lag phase between hair cycles, is prolonged, contributing to a higher percentage of empty follicles and advancing balding process.

Miniaturisation of follicle: A key characteristic seen in the histology of AGA. Hair follicles are composed of both mesenchyme and ectoderm. The epidermal invagination towards the dermis and subcutaneous fat constitutes the ectodermal part. The hair shaft is produced by the hair within the hair bulb. Mesenchyme component comprises of dermal papilla, a specialized group of fibroblasts fully enclosed within hair bulb. The size of the shaft is determined by the size of hair bulb, which in turn is influenced by the size of dermal papilla. Hair follicles become smaller, resulting in hair which are thinner. The diameter of the shafts decreases from approximately 0.08mm to that of less than 0.06mm. The brief phase (androgen), influence would also clarify considerable delay observed within the clinical response & beginning of treatment, as any medical intervention would only impact the miniaturization process.

Follicular miniaturization results in the formation of stelae, which are dermal residue of the original larger follicles. These stelae, which are sometimes referred to as “fibrous tracts” and sometime to “streamers”, identify the position of full-sized follicle by extending to subcutaneous tisue and up the former follicular tract to miniature hairs. Arao-Perkins bodies, detectable with elastic stains, can be observed within the follicular stelae. At the beginning an Arao-Perkins body starts as a little bundle of elastic fibers located in the neck of the DP. The bundles then congregate during the catagen phase and continue to exist at the follicular stelae's lowest site of origin. When an androgenetic alopecia patient experiences progressive shortening of their anogen hair, their stelae—groups of numerous elastic hairs—resemble rungs on a ladder.

There are two concurrent patterns associated with hair loss: i) a macroscopic pattern and ii) a microscopic pattern. The pattern (microscopic) is most noticeable on the vertex scalp, characterized by baldness originating from a central focal point and spreading outward in all directions without any intervening areas of unaffected hair. This pattern lacks skip lesions and is attributed to genetic factors influencing the follicle.

Microscopic pattern pertains to how hair loss occurs within the follicular units. In contrast to hair on the beard, scalp hairs originate from compound follicles, where two to five hairs usually emerge from a single pore.. Miniaturization in follicular units follows a systematic process, resulting in a decrease in fully developed hair per follicular unit. This reduction in hair density can be observed using dermoscopy and is experienced by individual as decrease in hair volume. As miniaturization progresses and all hairs undergo diminishment, the affected individual perceives increased visibility, interpreted as baldness.

Dermoscopic images depict various stages of alopecia on the scalp.

A) A normal scalp typically shows 2-4 hairs in most follicular units.

B) Advanced stages in AGA reveal predominantly thin and single hairs in most follicular units.

C) Early stages in AGA exhibit a combination of multiple and single hairs inside follicular units.

Inflammation is noted in Male Androgenetic Alopecia. Scalp biopsies have revealed activated T-cells infiltrating the lower parts of follicular infundibula. Around 40% AGA cases display an adequate perifollicular lymphohistiocytic infiltrate, potentially accompanied by parallel layers of deposit of collagen, a phenomenon less common in

normal controls (about 10%). Occasionally, eosinophils and mast cells are also observed. Inflammatory changes may extend to lower follicles and, in a few instances, include follicular stelae. Notably, a significant discrepancy in inflammatory infiltrate between the balding scalp portion and non-balding scalp portion is observed.

The possibility of a gradual inflammatory scarring process has been proposed considering irreversible nature of hair loss and the histological presence of fibrous tracts.

Male Pattern Hair Loss Classification

Hamilton

Hamilton organised a comprehensive research involving more than 700 individuals of diverse sexes, ethnic backgrounds, and ages to develop the initial classification for Male Pattern Hair Loss (MPHL). This inclusive approach encompassed individuals ranging from fetuses to the elderly, ensuring thorough examination of all scalp types and facilitating accurate classification from totally unaffected to severely affected scalps. In the Hamilton classification system there are two primary sections: i) those with scalps categorized as "not bald" comprises types I–III and ii) the "bald" category encompasses types IV–VIII.

- Type I : Absence of bilateral recessions along the frontoparietal region's anterior hairline. A variation of this type known as type IA includes people whose complete anterior hairline is positioned high on the forehead.

- Type II : According to the classification by Hamilton, it involves triangular recessions in the frontoparietal region, stopping short of extending beyond a point 3 cm frontward to a line segment drawn between the external auditory meatuses (midcoronal

line). While there may be some loss of hair over the mid-frontal border, typically less affected compared to frontoparietal regions.

- Type III: Characterized by marginal conditions and loss of hair that present difficulties in classification. These challenges arise due to factors such as scarring, asymmetry, unconventional patterns of hair thinning, and other variables.

- Type IV: The minimum level of hair loss indicative of baldness. In the frontotemporal areas, this stage is distinguished by prominent triangular recessions that extend posteriorly beyond the point three cm beyond the midcoronal line. Additionally, akin to the Type II section, most individuals encounter hair loss in mid-frontal area. When hair loss manifests in a broad band along whole frontal hairline, grouped as Type IV. In elderly individuals, on the crown, there may also be additional hair loss, referred to as “Type IV old”.

- Type V: Compared to Type IV, there are noticeable frontoparietal recessions and concomitant crown hair loss.

- Type VI: Frontoparietal regression, with a little patch of hair remaining on the mid-frontal area, resembling a horseshoe shape when viewed from above. In addition, there is crown hair loss that resembles Type V but is not the same as frontoparietal regression. The hair patch in the mid-frontal region may be sparse or absent in the variation type, Type VI.

- Type VII and VIII: Frontoparietal regression with a horseshoe-shaped appearance that is not distinguished from the hair loss on the crown. A hair clump with at least 100 coarse terminal hairs within the horseshoe-shaped scalp area is used to distinguish between Type VII and VIII.

Norwood Hamilton

In the year 1975, Dr. Norwood examined about a 1000 Caucasian males and, drawing from Hamilton's classification, adapted it to better align with observed stages of hair loss. This resulted in the Norwood Hamilton classification, which since has become the commonly used classification system for hair loss.

Norwood-Hamilton classification:

Type I: Minimal recession or disappearance along the frontotemporal region's anterior border.

Type II: Hairline frontotemporal regression that stops no more than 2 cm in front of the midcoronal line.

Type III: The hairline's frontotemporal recession goes over Type II's boundaries and may even touch the midcoronal line.

Type IV: In this kind, the frontotemporal recession extends past the midcoronal line.

Type V: Compared to Type IV, this kind has more severe hair loss and the denuded area includes the vertex.

For the Type A variant, 2 major features must be present, while two additional optional minor features. Major features include, i) progression of frontotemporal recession without leaving hair at the region (mid-frontal), and ii) no development of a bald parts on vertex, with recession of front hairline continuing backwards. Minor features may include: i) persistent sparse hair distribution, and ii) wider and higher-reaching horseshoe like shaped hair pattern remaining on the side and back region.

Basic and specific

In 2007, Lee et al., introduced BASP classification, represents the latest system aimed at achieving a balance between factual, practicality, and repeatability. It comprises two main categories: basic & specific.

In the basic types of the BASP classification, the structure of hairline (anterior) is described using 4 letters L, M, C & U, representing appearance as seen from above. The exception is 'L', which signifies a Linear shape. Mostly clinical history plays a significant role in determining basic classification, as it relies on the patient's own subjective perception of their original anterior hairline.

Basic & specific classification

- Type L: The frontotemporal region's anterior boundary shows no signs of regression. Typically no loss of hair[1] with linear hairline.
- Type M - Recession that resembles letter M is seen on the anterior hairline[1]. Based on severity, this type is further subdivided into four subgroups.
- Type M0 - Original hairline like M letter.
- Type M1 – frontal hairline retracted backward, it hasn't gone past to ventral third along virtual line that connects top of vertex to the original hairline.
- Type M2: true hairline and vertex top are connected by a virtual line, with anterior hairline receding backwards & never exceeding middle third along the line.
- Type M3: frontal hairline moved behind middle third portion and into posterior third along virtual line that connects vertex to original hairline.

• Type C: A receding hairline that resembles the letter C is present[1]. Shaped like a half circle. Depending on severity, it is divided into four subtypes.

• Type C0: There is no apparent hair loss, and true hairline is alike letter C.

• Type C1: The hairline at the front has retracted to the ventral third of virtual line that connects vertex to initial hairline1.

• Type C2 - front hairline retracted towards center 3rd along virtual line that joins top of vertex to initial hairline1.

• Type C3: Top of vertex and dorsal 1/3rd of virtual line's true hairline have retreated from front hairline.

• Type U: The front hairline in this type has gone backwards towards vertex, creating shape resembling a horseshoe and letter U. Severe kind of hair loss is represented by this category.

• Type U1: The posterior occipital protuberance and vertex are connected by a virtual line, with anterior hairline receding into the superior third of this line.

• Type U2: Frontal hairline has retreated into central 3rd along virtual line joining posterior occipital protuberance & vertex.

• Category U3: frontal hairline retreated towards inferior 3rd on virtual line joining posterior occipital protuberance & vertex.

These types are separated into three subclassifications, all with its own comparable degrees of severity, according on their position, which can be either frontal (F) or vertex (V). The detailed breakdown of each specific type and its subclasses is provided below.

• Type F/V1: There is simply a noticeable overall reduction in hair density.

- Type F/V2: Noticeable overall decline in hair density.

- Type F/V3: There is only extremely thin or absent hair due to a severe general decline in hair density.

The blend of basic, specific, and its subtypes determines final type. For instance, final type C1V1 is indicated by basic type (C1) + particular type (V1). Comparing to previous categories, a physician may more easily visualize the clinical picture by utilizing a coalition resembling contour in frontal hairline & site among diminished density of hair. Additionally, this classification is not limited to MPHL; it can also be applied to hair loss with a female pattern. In addition, this approach is more easily learned, retained, and applied in ordinary clinical practice than the earlier classifications.

Mechanism of hair loss: Diffuse hair thinning

A couple of years may pass before diffuse hair thinning and occasionally enhanced hair shedding manifest as clinical baldness. This is due to probability that not every follicle within a follicular unit (FU) is impacted by the follicular shrinkage process that takes place in AGA. Rather, FUs exhibit levels or grades of follicular miniaturization, with major follicles being miniaturized last and secondary follicles being impacted first.

Histology of follicles

The best way to see the FUs that eventually become scalp hairs is with a horizontal biopsy of scalp. The follicular units consist of 1^{o} follicle, brings about the Arrecter Pili Muscle, several subsiquent follicles that develop distal to APM & a sebaceous gland. Generally, the hairs that emerge from secondary follicles are created by 1 infundibulum. However, beard, trunk, and limbs hair either grow alone or in Mejeres trios, which are groups of

three hairs. Hair density decreases due to shrinkage of secondary follicles before baldness becomes visible. Baldness is the outcome of every hair inside a FU being miniaturized.

A hairy scalp's horizontal skin biopsy segment displaying premature androgenetic alopecia characteristics. The sebaceous gland, APM become vellus hairs, make up follicular units. Follicles are found within these units.

In androgenetic alopecia, the occurrence of baldness is preceded by reducing hair per follicle.

Role - Arrector Pili Muscle(APM) for androgenetic alopecia

The intriguing topic is whether alopecia areata lesions exhibit the same histologically observed miniaturization of hair follicle. The Miniaturization of complete follicles happens simultaneously in this disorder.

Testing APM, to be specific, it may help to understand this seeming inconsistency. Arrector Pili Muscle is a thin confined strip of smooth muscle which connects epidermis & the nearby upper dermis of hair follicle. The muscle helps in sebum secretion and thermoregulation. Bulge at which APM originates proximally.

APM in androgenetic alopecia slowly loses its connection to the bulge of the hair follicle and is gently replaced by adipose tissue[4].

Cell migration between dermal papilla and dermal sheath 12 is linked to follicle cycle. Hair follicle shrinking is assumed to result from disturbance in alopecia. The APM may also be maintained by cells from the follicle mesenchyme, and reduction in population of progenitor cell sustaining dermal papilla and APM could also be a reason for the muscle degeneration observed in AGA.

Compound follicular units make up scalp follicles. Miniaturization starts in the secondary follicles in androgenetic alopecia. This causes a decrease in hair density that occurs before baldness becomes noticeable. A bald scalp only shows when every hair in a follicular unit is reduced in size. Initially, the muscle loses its link to the secondary follicles as it gets smaller. Hair loss becomes irreversible when primary follicles gradually shrink and lose their ability to attach muscles..

The APM stays linked to the primary follicle during the early phases of hair loss, but in certain FUs, some of the regressing secondary follicles lose contact with it.. The remaining FUs also experience secondary follicular shrinkage and APM separation from these follicles. As the condition worsens, the muscle in the impacted FUs entirely loses its attachment to the secondary follicles and continues to shrink. Eventually, primary follicles shrink, which makes baldness more noticeable. Hair loss is irreversible when muscular connection to main follicles is lost.

Platelet-Rich Plasma in Androgenetic Alopecia

PRP must have 1,000,000/mL within 5 mL of whole blood[5], or > four times baseline platelet count[6]. These recommendations were standardized in a 2014 study by Dhurat et. al. using the repeated hit, try, and error method. Numerous elements covered in this seminal article were demonstrated to impact PRP's ultimate result and methodologyHowever, a large number of research use different techniques and supplies to make PRP, therefore the diversity in the outcomes is quite high. PRP is hindered by interindividual variability and operator dependency more than PRP itself, which is the biggest obstacle in this sector.

PRP mechanism

PRP[7] a portion in blood plasma[8] with a higher-than-baseline platelet content. Platelets are no longer only linked to hemostasis, contrary to prior knowledge. They are currently recognized as a repository for GFs[9]. When the platelets degranulate, these GFs are released. They induce angiogenesis[10], migration, differentiation, and proliferation of cells, all together have an impact on the milieu of the tissue they are released into. Growth factors[11]: PDGF[4], VEGF[12], (FGF) Fibroblast Growth Fcator, (EGF) Epidremal Growth Factor, Hepatocyte Growth Factor, Insulin-like Growth Factor 1 & 2 [13h] & matrix metalloproteinases 2 & 9[14].

A different number of GFs regulate the hair cycle. A research by Akiyama et al. looked at the GF receptor's location on the human fetus's bulge stem cells. On each of the bulge cells, they discovered strong tagging of EGF[15] and receptors of transforming growth factor-alpha[16], indicating a function in development and differentiation. Additionally, a distinct labeling pattern of PDGF receptors was discovered, suggesting a function for these receptors in the communication between the bulge and surrounding tissue.

The WNT/b-catenin pathway is one more important mechanism involved in the creation of human hair follicles. This pathway is mostly active during the development of embryonic hair. Studies have also revealed that the WNT/b-catenin pathway is activated during anagen activation, which is the stage of adult hair growth. B-catenin is stabilized as a result of WNT ligands activating the WNT pathway. b-catenin migrates to the nucleus, where it activates a range of target genes that are concerned with activities related to WNT pathway[17], including cell division, migration, and maturation. Myung et al.'s research illustrated that the WNT pathway has to be activated in order for anagen hair[17]. Additionally, adult wound-induced hair neogenesis, another mechanism of hair

regeneration, also involves activation of this developmental route. Ito et al. showed that following wound healing, new hairs might grow from scratch. An intact WNT/b-catenin pathway was necessary for this follicular neogenesis, and the amount of regenerated follicles that rose when WNT ligand was overexpressed.

The ERK/Akt pathway, is the third mechanism that has been linked to the hair growth. Signaling pathways of ERK[18] along with protein kinase B[19] facilitate the growth of cells and inhibit apoptosis.

Li et al. used PRP to treat cultivated DP cells in order to study the influence of PRP on hair growth. They discovered that PRP enhanced FGF-7[20] & b-catenin[20] and the proliferation in DP cells. Additionally, Akt and ERK signaling were stimulated. By promoting angiogenesis and neovascularization[21], PRP increases hair growth.

FGF-7 prolongs the anagen phase. cell proliferates from signal of ERK; activation of Akt causes the release of Bcl-2, an antiapoptotic protein; and b-catenin promotes the growth of hair follicles. The other GFs promote neovascularization and growth of hair follicles.

PRP preparation

For AGA, double - spin method, recommended way to prepare PRP[22]. AGA-prepared PRP needs to be customized to the disease's requirements. Amount of platelet should ideally be > 1 million platelets/μl—in a volume of 5 to 7 mL. Because it allows for variations in the volume of blood collected and PRP prepared.

Blood is collected into sterile, disposable containing anticoagulant. Tubes are then spun at a low speed in a centrifuge. The liquid above the sediment is moved into two fresh, sterile tubes[23] following the first centrifugation, and at a higher RPM second centrifugation[24] is done. After spin sedimentation platelets get pelletized. Platelet pellet

is dissolved in the bottom one-third volume of plasma[25]. While upper two-thirds is disposed. Which commercial kit[26] is optimal for making PRP. It is necessary to select the devices that generate minimum of 5 to 7 mL of PRP and have a better platelet yield[27].

AGA requires at least 3-5 PRP sessions, with a one-month interval between each session. The total amount of sessions needed is also advised. The best patient subset for PRP is those with an AGA categorization of Grade II to V according to Norwood Hamilton.

The suggested dosage is 0.05 - 0.1ml/cm², and an overall of 5 to 7 mL of PRP is needed.

Volume of PRP needed is 7&1/2ml (Volume injection/ site × area of scalp), assuming that the bald scalp area is 150 cm². In smaller treatment areas, a lower amount can be needed. 5 to 7 milliliters is the suggested volume. Every study has utilized a consistent distance of 1 cm between injection sites.

Method

By using either syringe for insulin or a smallbore tuberculin syringes.

In soft tissue that contains collagen, like the dermis, platelet activation is not necessary. Gentile et al. examined the outcome of using both nonactivated & activated PRP in AGA[28]. Compared to activated PRP, they observed a greater raise in hair density & count in nonactivated. An additional explanation could be that the endogenous PRP activation facilitates the synthesis of thromboxane A2 (TXA2), which in turn activates more platelets and intensifies platelet aggregation. Within an hour of external platelet activation, 95% of the GFs are released. But PRP releases GFs for up to ten days after platelets are physiologically activated.

IPRF in AGA

Miron et al. described injectable PRF, or I-PRF, in which blood was centrifuged in special plastic tubes that inhibited blood with no anticoagulant. For three minutes, blood was spun at a modest speed of 60 G. This resulted in a solution, which clots in fifteen to twenty minutes on average. It has been illustrated that the liquid form of PRF releases GFs in a much more regulated manner and generates more cumulative GFs than PRP. When it comes to slow-growing disorders like AGA, this is quite helpful. The amplification of platelet concentration in IPRF is 2.7 times lower compared on PRP, whereas PRP is 5 to 6 times higher. In their carefully monitored trial, Schiavone et al. found that patients with hair loss of all ages and genders responded well[23]. To determine the effectiveness of I-PRF in treating dermatological disorders such as hair loss, more study in this area is necessary.

In 2019, Arora R et al evaluated i-PRF as an alternative to PRP. Following surgery, the authors observed mild bruising and scalp inflammation that persisted for two to three days. There was no discomfort, and there was no need for painkillers. In Case 1, participant was content in quantity of hair growth[29] after four i-PRF therapy sessions and requested no more sessions. In Case 2, the same thing was noted. Nevertheless, in Case 3, which is typically challenging to treat, the patient saw some modest hair growth and agreed to continue receiving i-PRF treatments. The authors propose that i-PRF, which may be applied anywhere growth and regeneration are needed, is superior to PRP. Hair growth improved in every instance. If you want better outcomes, you can lengthen the sessions.

In a cross-sectional study in 2022, Michelle V et al. evaluated hair density and hair diameter variance in connection to the severity grade of FPHL[30]. The authors discovered

that a decline in average hair shaft diameter over the frontal and occipital scalps, and also a fall in hair density over both, positively linked with an increase in illness severity from grade one to grade three. The authors came to the conclusion that trichoscopic instruments, in particular hair density and hair diameter variance over the occipital and frontal scalp, can be helpful in assessing the severity and course of FPHL disease.

In 2023, Balasundaram M et al evaluated the safety and effectiveness of topical minoxidil in AGA versus a standardized non-activated PRP preparation. At week 24, the authors discovered that 38% of participants responded to PRP and 56% to minoxidil arm. By week 12, there was a noticeable rise in both the target area's hair count and density among the groups. In PRP & minoxidil arms, adverse events happened in 53% and 37% of cases, respectively. With minoxidil, the patient were more satisfied comparatively.

Meijia Li et al. assessed impact of PRP monotherapy regarding the management of androgenetic alopecis in a meta-analysis published in 2024[20]. The PRP group's hair density was notably more than control group, two groups' hair diameters did not significantly differ[20]. Subgroup analysis demonstrated the mixed-sex populations, hair density was considerably higmore in studies including exclusively men. Furthermore, hair density was unaffected by the year of publication or the split-head design. On the other hand, studies < thirty participants had noticeably elevated density of hair. The PRP treatment improved hair density but not hair diameter in individuals with AGA. With injections of PRP, tendency toward different treatment effects by gender, which calls for more research.

MATERIALS AND METHODS

Source of Data: The present study will be conducted at KLE'S DR. PRABHAKAR KORE HOSPITAL AND MRC, Belgaum on patients having androgenetic alopecia.

Study Design: Interventional study.

Study Period: JANUARY 2023- DECEMBER 2023

Sample Size: 36

$n = (2*(Z_{(\alpha/2)}+Z_{\beta})^2)/(|\mu_1-\mu_2|/\sigma)^2$

$d = |\mu_1-\mu_2|/\sigma$

Where μ1 is t $Z_{(\alpha/2)} = 1.96$ for 95% confidence level, where μ1 is the first group's mean, μ2 is the second group's mean, and σ2 is the common error variance and for 80% power Z_{β} values are 0.84 and assuming d as 0.7, sample size given by,

$n=(2(1.96+0.84)^2)/(0.7)^2$

$n=33.3$

By considering 10% lost to follow-up cases, final sample size is given by:

$n=33.3+(33.3\times0.1)$

$n=36.3 \approx 36$

Total sample size required: 36 patients.

Sampling technique: Convenient sampling.

Inclusion Criteria:

1. Males.

2. Age: 18 to 50 years.

3. Norwood classification grading II, III, IV, V.

Exclusion Criteria:

1. Females.

2. Age: < 18 years and > 50 years.

3. Norwood classification grading VI, VII.

4. Subjects who are diagnosed cases of coagulopathies, inflammatory disorders of scalp and auto immune disorders

Study protocol: All clinically diagnosed patients of androgenetic alopecia who fulfill the criteria for inclusion will be evaluated with detailed history and trichoscopy. Institution Ethics Committee Clearance (MDC/JNMCIEC/245) was obtained before commencement of the study. Data must be recorded in the form of questionairre and images should be stored. The Clinical Trials Registry has the trial registered. – India(CTRI)(CTRI/2023/10/059182)

8.9 Data collection procedure:

A) All patients with Androgenetic Alopecia (AGA) attending Belgaum's KLE'S Dr. Prabhakar Kore Hospital and MRC shall be recruited.

B) Informed consent will be taken from all the patients enrolling.

C) All patients in the study would undergo a detailed taking of their history, a general physical and then systemic & dermatological examination.

D) In this study, 4 treatment sessions of platelet-rich plasma injection on the scalp (left side) and Injectable-platelet-rich fibrin on the right side of the scalp, at 4 4-week intervals will be done. Under all aseptic precautions, 30 mL of whole venous blood is withdrawn from the antecubital vein via a scalp vein catheter. 24ml is collected into two sterile conical bottom centrifuge plastic tubes that is 12ml in each tube. No anticoagulant is added to the tubes for I-PRF. The tubes are then immediately placed diametrically opposite to each other inside the centrifuge fitted with a bucket-handle/swing-out handle type of rotor (RemiR4c model), and centrifuged at 800 rpm for 4 minutes. The tubes are removed and the upper yellow-orange-colored liquid obtained is injectable PRF. I-PRF is filled in insulin syringes. 1 unit of I-PRF/cm^2 injections are done on the right side of the scalp. Now, PRP will be prepared by collecting 6ml of blood in three vials having Anticoagulant 3.2% sodium citrate[31] in BD Vacutainer (BD Company, Bangalore, India) blood collection tubes, that is 2ml in each tube. Sodium citrate vials will be used to inhibit platelet aggregation. It will then be centrifuged by double-spin method. Soft spin is for 6 min at 1500 rotations per minute. Hard spin is done by separating PPP with the buffy coat in a plane vacutainer without anti-coagulant and centrifuge at 2500 RPM for 15 minutes[32]. The product thus obtained is filled in insulin syringes. 1 unit[33] of PRP/cm^2 injections is done on the left side of the scalp.

E) Digital trichoscopic images will be captured using consistent camera settings, patient positioning, and room lighting during each session, both initially and subsequently. Image-J software is used to analyze the hair parameters.

F) Data will be gathered by a particular examiner and undertaken in case record proforma.

G) Records will be maintained and analyzed statistically

Data processing and analysis/statistical analysis:

Statistical analysis

Microsoft Excel and statistical software R version 4.1.2 would be used for data analysis. Variables that are continuous will be represented using mean ± sd/median (minimum, maximum). Variables that are categorical will be represented using frequency (percentage). Categorical data will be studied and investigated. The value of "p </= to 0.05" indicates significance in statistics.

RESULTS

Distribution according to mean values of various parameters

Mean age within participants in study was 33.22 years, mean duration of AGA was 5.22 years, the mean hair diameter in micrometers was 42.28, and the mean hair density was 93.01hair/sq cm. Mean hairs per follicle unit was 2.08, and the mean inter-follicular distance was 592.85 µm. Mean number of empty follicles was 15.56.

Table 1 - Distribution according to mean values of various parameters

Descriptive statistics table	Minimum score	Maximum score	Mean score	standard deviation
Age group	21	47	33.22	7.21
Duration of AGA in years	2.00	9.00	5.22	1.74
Hair diameter (µm)	34.97	47.80	42.28	2.89
Hair density (Per sq cm)	70.00	122.50	93.01	18.37
Number of hair per unit follicle	1.00	3.00	2.08	0.61
Inter-follicular distance (µm)	469.50	697.00	592.85	74.95
Empty follicles	9.00	21.50	15.56	3.29

Chart 1 - Distribution according to mean values of age

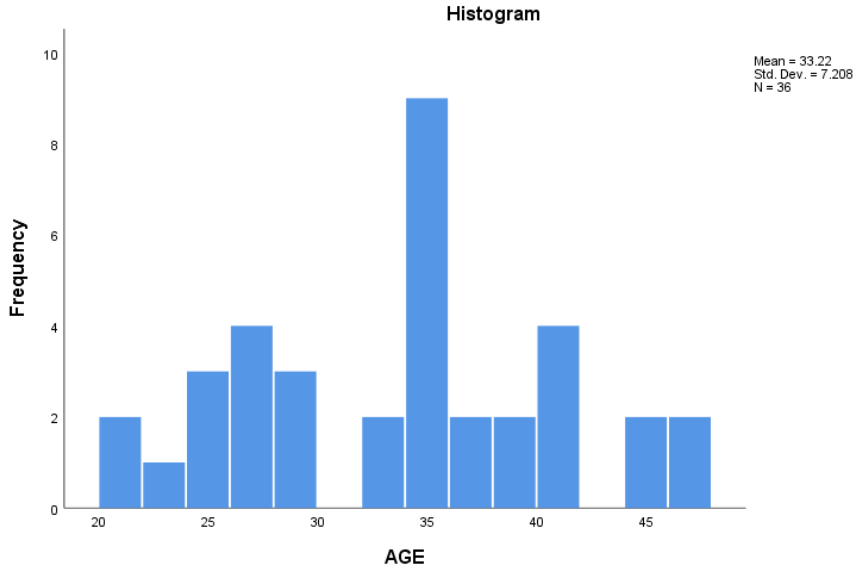
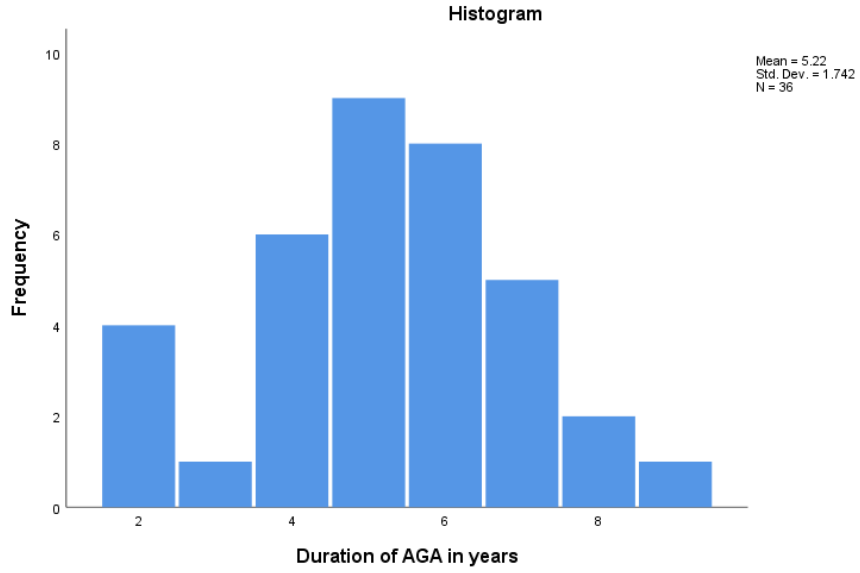


Chart 2 - Distribution according to mean values of duration.



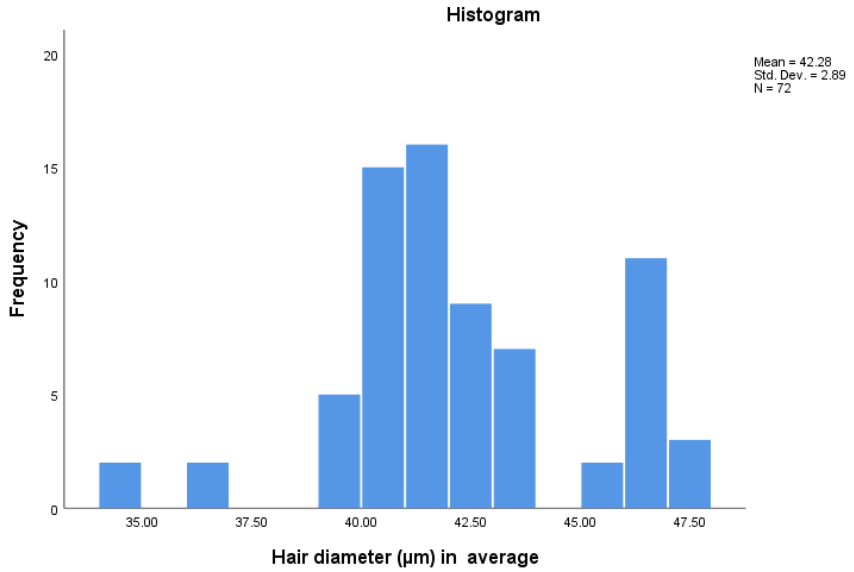


Chart 3 - Distribution according to mean values of hair diameter

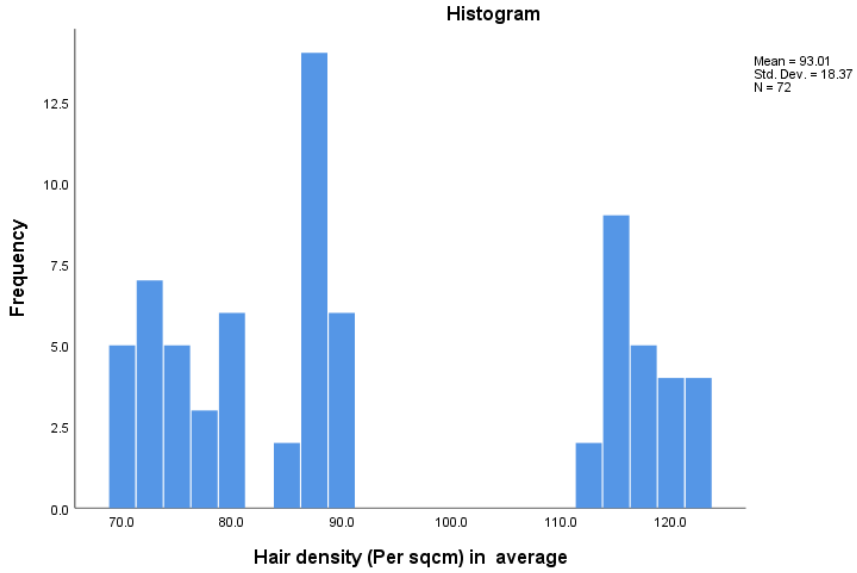


Chart 4 - Distribution according to mean values of hair density

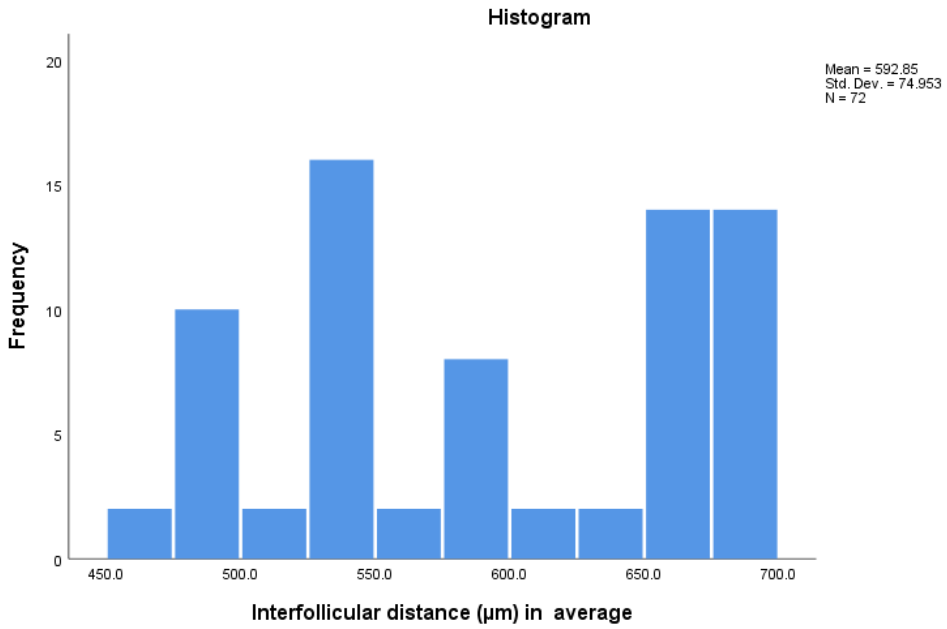


Chart 5 - Distribution according to mean values of interfollicular distance

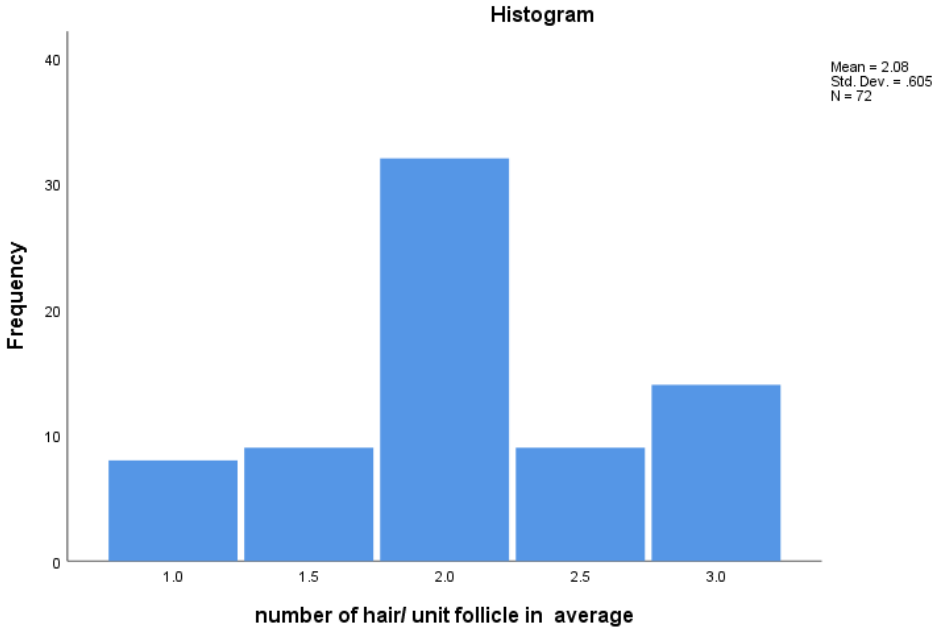


Chart 6 - Distribution according to mean values of number of hair/unit follicle.

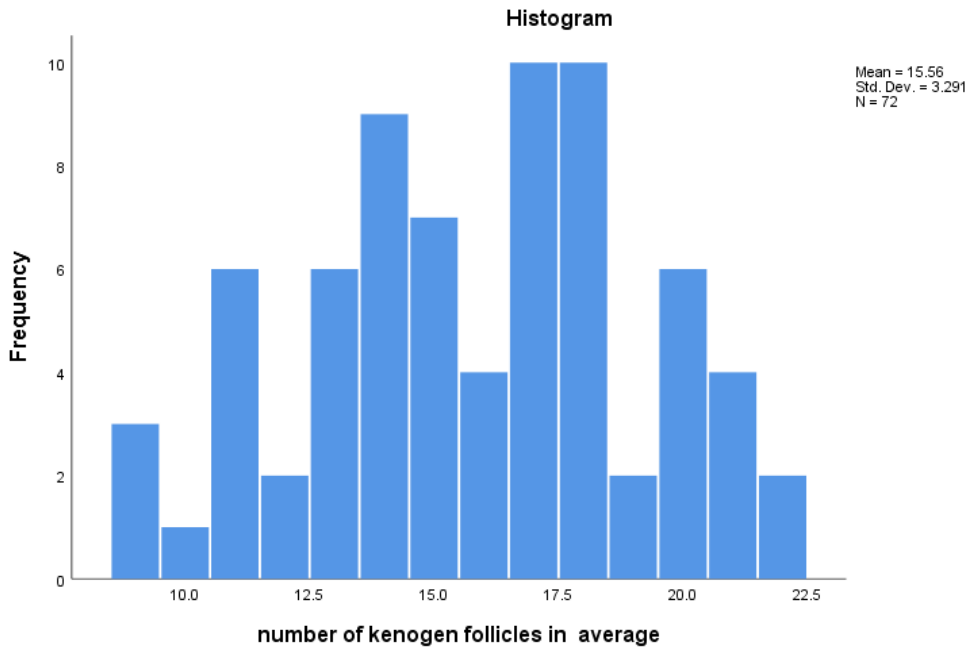


Chart 7 - Distribution according to mean values of number of Kenogen follicles.

Distribution according to gender

All the cases were male

Table 2 - Distribution on gender

Sex	Number	%age
Male	36	100.00%

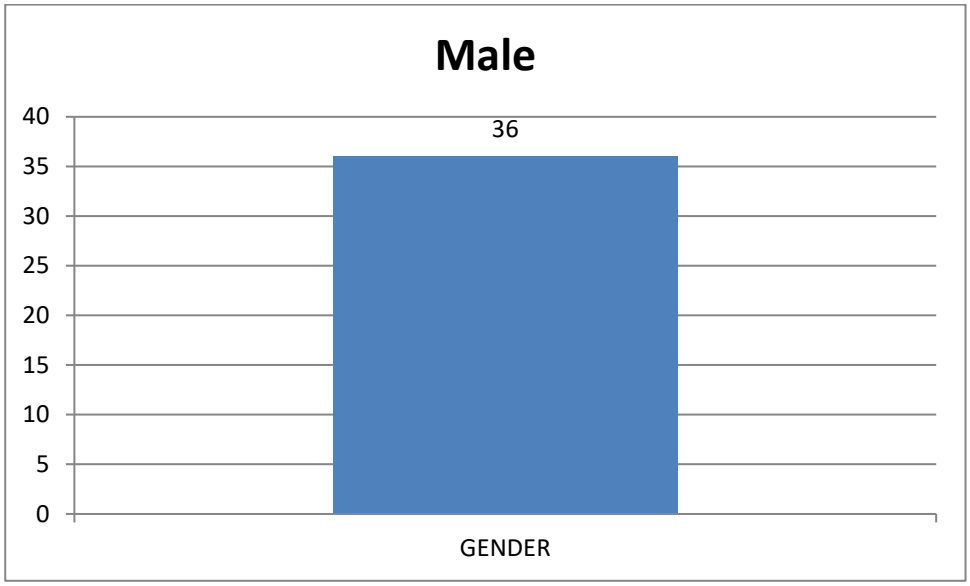
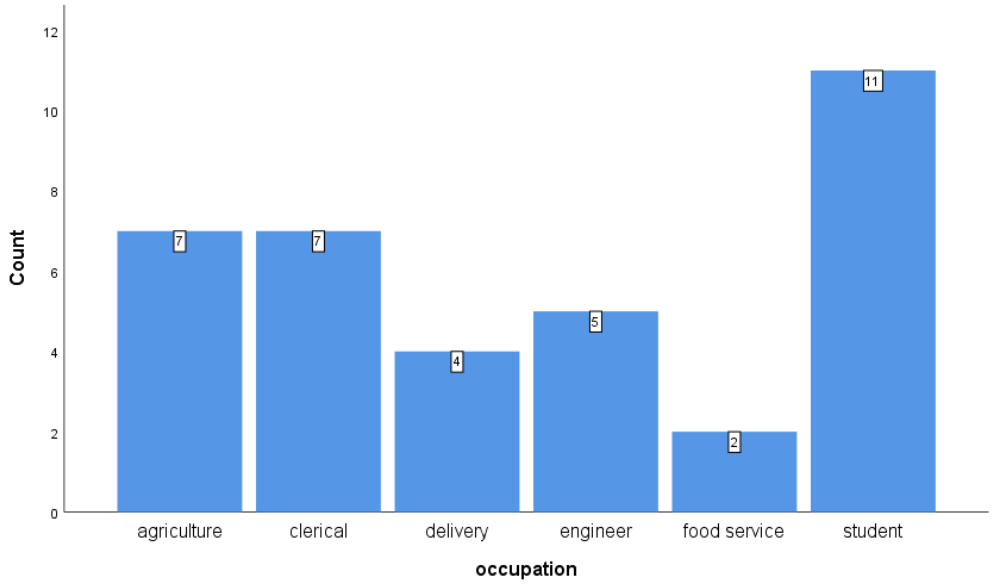


Chart 8 - Distribution according to gender

Table 3: Descriptive Statistics

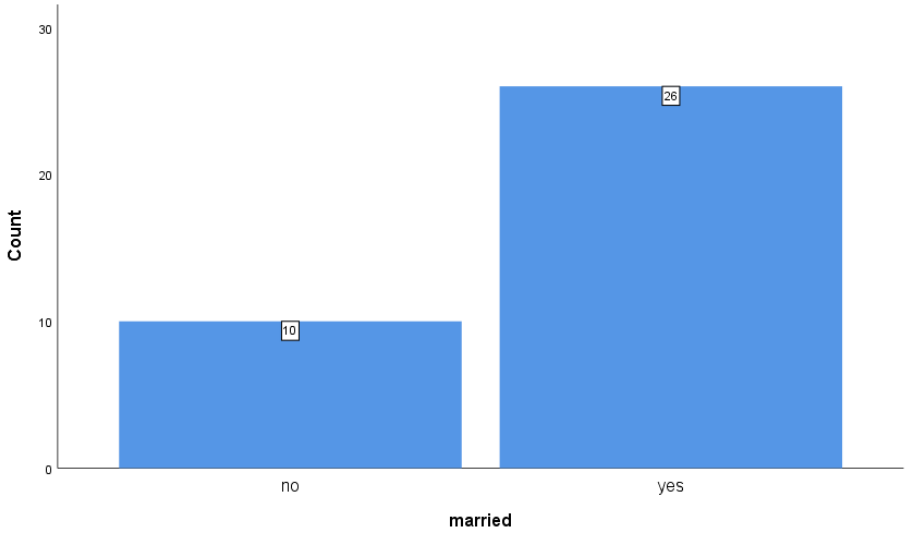
VARIABLES		FREQUENCY	PERCENTAGE
occupation	agriculture	7	19.40%
	clerical	7	19.40%
	delivery	4	11.10%
	engineer	5	13.90%
	food service	2	5.60%
	student	11	30.60%
married	no	10	27.80%
	yes	26	72.20%
family history	no	7	19.40%
	yes	29	80.60%
Grade	2	9	25.00%
	3	9	25.00%
	4	13	36.10%
	5	5	13.90%
PRP VAS Satisfaction	Not Satisfied	16	44.40%
	Slightly Satisfied	17	47.20%
	Very Satisfied	3	8.30%
PRF VAS Satisfaction	Not Satisfied	25	69.40%
	Slightly Satisfied	11	30.60%
	Very Satisfied	0	0.00%
PRP assessment Dermatologist in %age	0-25%	21	58.30%
	26-50%	14	38.90%
	51-75%	1	2.80%
PRF assessment Dermatologist in %age	0-25%	16	44.40%
	26-50%	18	50.00%
	51-75%	2	5.60%
Mean Age		**33.22**	
SD Age		**7.21**	
Mean Duration of AGA in years		**5.22**	
SD Duration of AGA in years		**1.74**	

Chart 9a: Bar Graph of Occupation Distribution



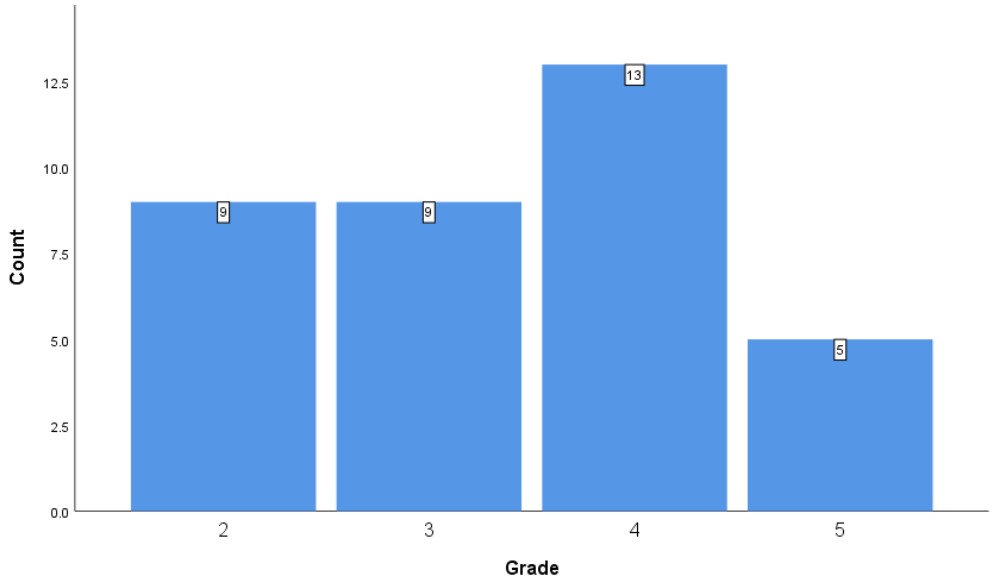
The most common occupation is students, comprising 30.60% followed by agriculture and clerical work, each at 19.40%. Engineers make up 13.90%, delivery workers 11.10% , and food service workers 5.60% .

Chart 9b: Bar Graph of Martial Status Distribution



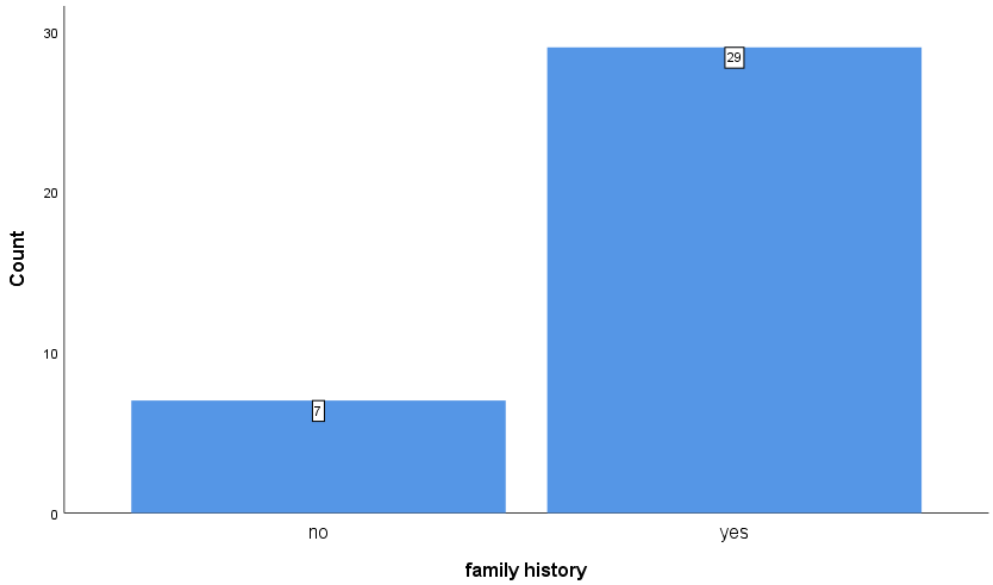
A significant majority of participants are married, comprising of 72.20%, while 27.80% are unmarried.

Chart 9c: Bar Graph of Grade Distribution



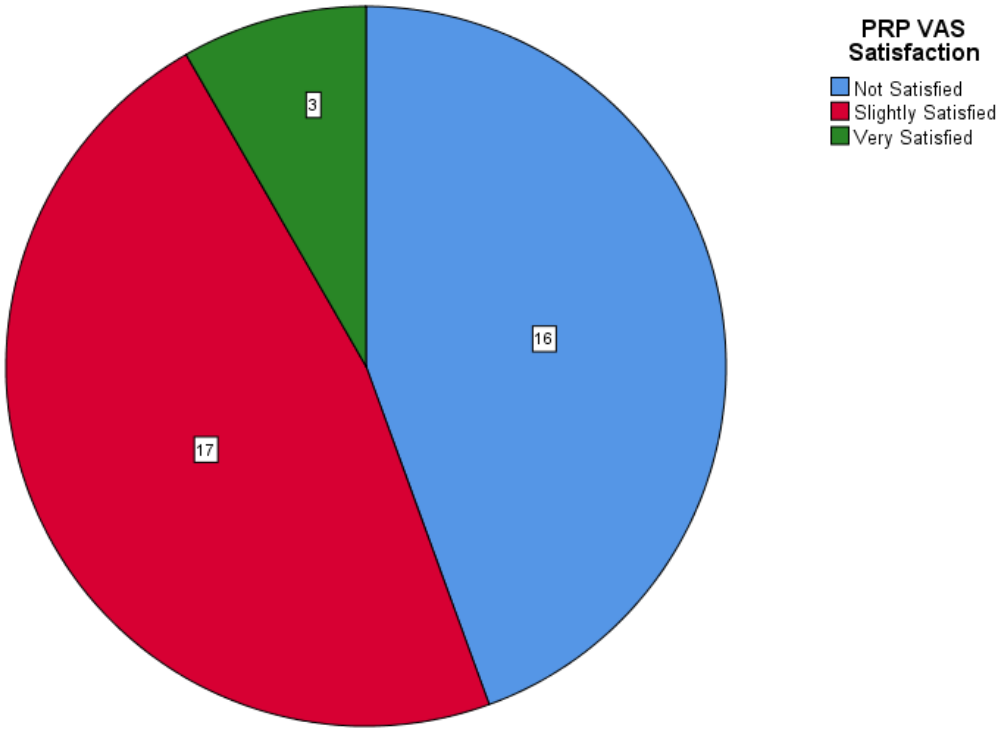
Grade 4 is the most common with 36.10% ,Grade 2 and Grade 3 each include 25.00% and Grade 5 is the least common at 13.90% .

Chart 9d: Bar Graph of Family History Distribution



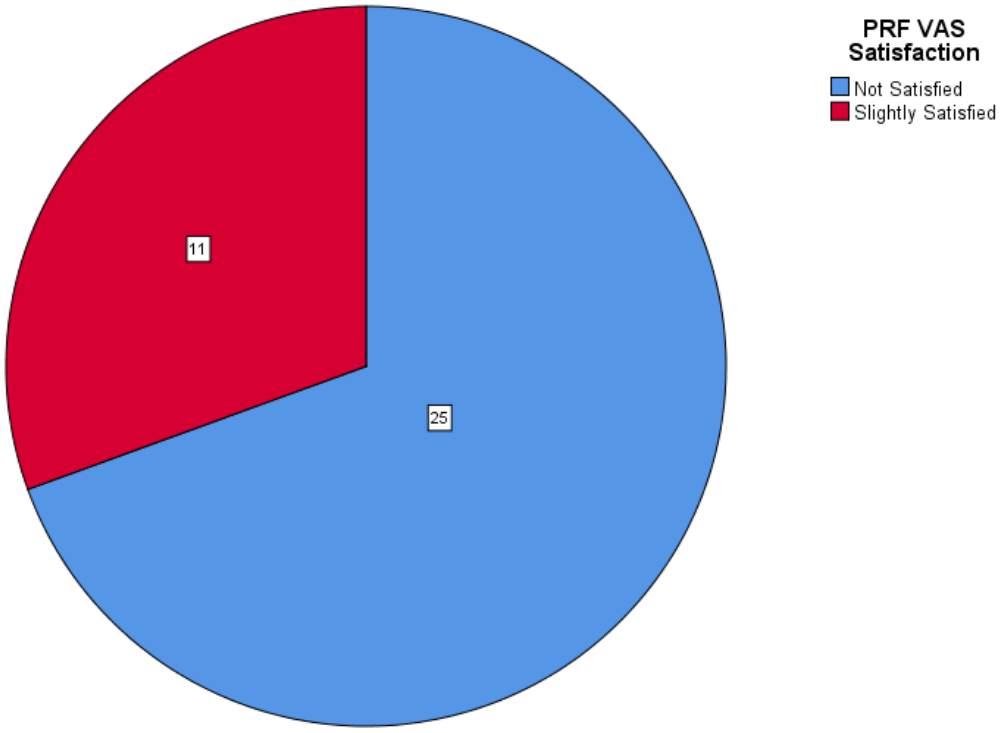
A majority of participants 80.60% reported having a family history , whereas 19.40% reported no family history.

Chart 9e: Pie Chart of PRP VAS Satisfaction



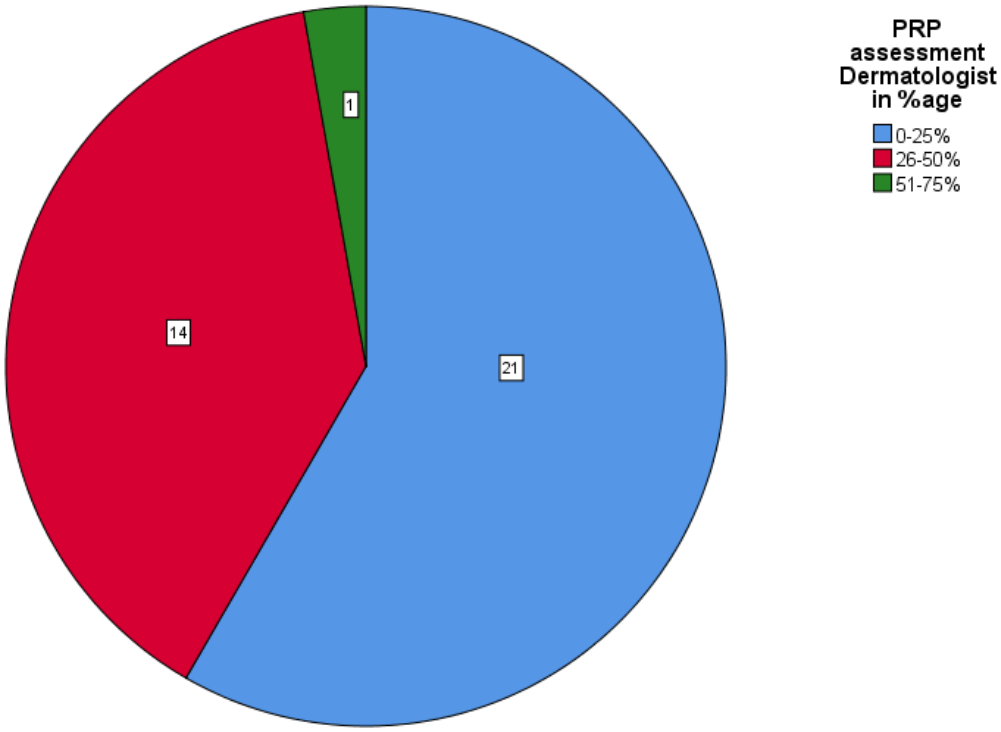
The satisfaction levels with PRP treatment show that 44.40% are not satisfied, 47.20% are slightly satisfied, and 8.30% are very satisfied.

Chart 9f: Pie Chart of PRF VAS Satisfaction



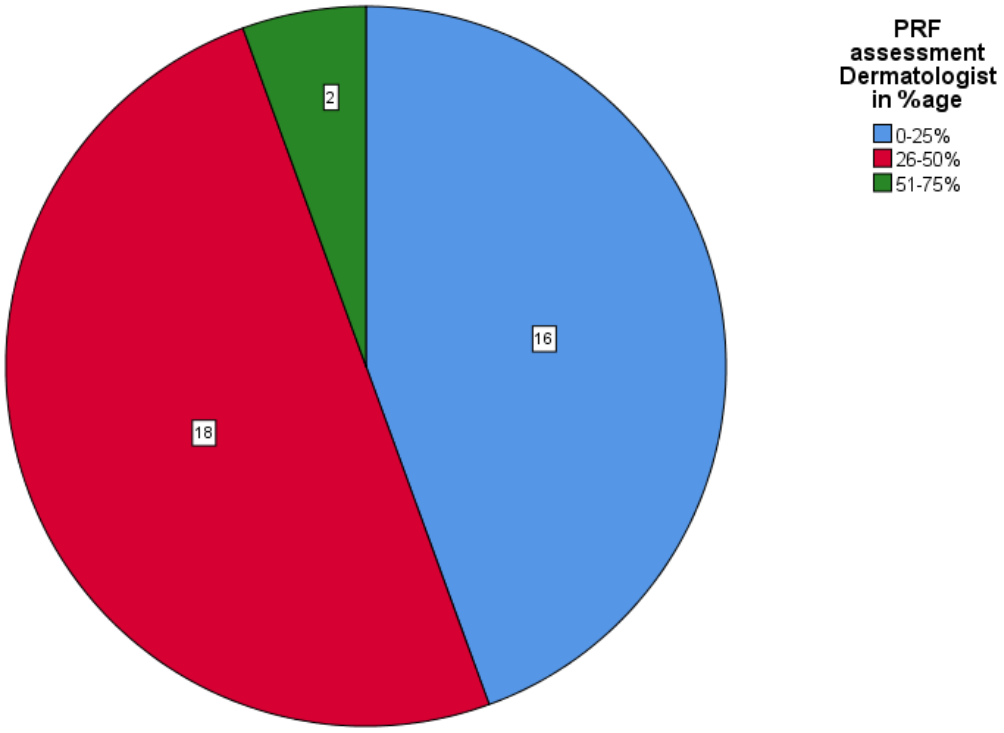
The satisfaction levels with PRF treatment show that 69.40% are not satisfied and 30.60% are slightly satisfied.

Chart 9g: Pie Chart of PRP Dermatologist assessment



The dermatologist assessment for PRP treatment shows that 58.30% fall within the 0-25% improvement range, 38.90% in 26-50% range, and only 2.80% are in 51-75% range.

Chart 9h: Pie Chart of PRF Dermatologist assessment



For PRF treatment, 44.40% are in the 0-25% improvement range, 50.00% in 26-50% range, and 5.60% in 51-75% range.

Table 4: Summary of Mann Whitney U Test by Hair Parameters and Treatment

Variable	Treatment	N	Median (IQR)	P value
Hair diameter (µm) in % Imp	**PRF**	**36**	**1.19(0.51,1.99)**	**0.137**
	PRP	**36**	**1.67(0.83,2.42)**	
Hair density (Per sqcm) in % imp	**PRF**	**36**	**0.89(0,1.27)**	**0.019***
	PRP	**36**	**1.27(0.85,2.31)**	
number of kenogen follicles in % imp	**PRF**	**36**	**-4.77(-6.67,0)**	**0.654**
	PRP	**36**	**-5.41(-6.67,0)**	
Interfollicular distance (µm) in % imp	**PRF**	**36**	**-0.15(-0.2,0)**	**0.846**
	PRP	**36**	**-0.15(-0.2,0)**	
number of hair/ unit follicle in % imp	**PRF**	**36**	**0(0,50)**	**0.85**
	PRP	**36**	**0(0,25)**	

*Significant

Mann-Whitney U test - to compare percentage improvement across various variables between two treatment groups: PRF and PRP.The results indicate a substantial variation in Hair density improvement (p=0.019) between two treatments. Specifically, patients on PRP Treatment showed higher improvement in Hair Density compared to PRF Treatment. However, remaining variables did not show significant difference among two groups.

Chart 10a.: Box plot of Distribution of Hair Diameter Improvement by Treatment

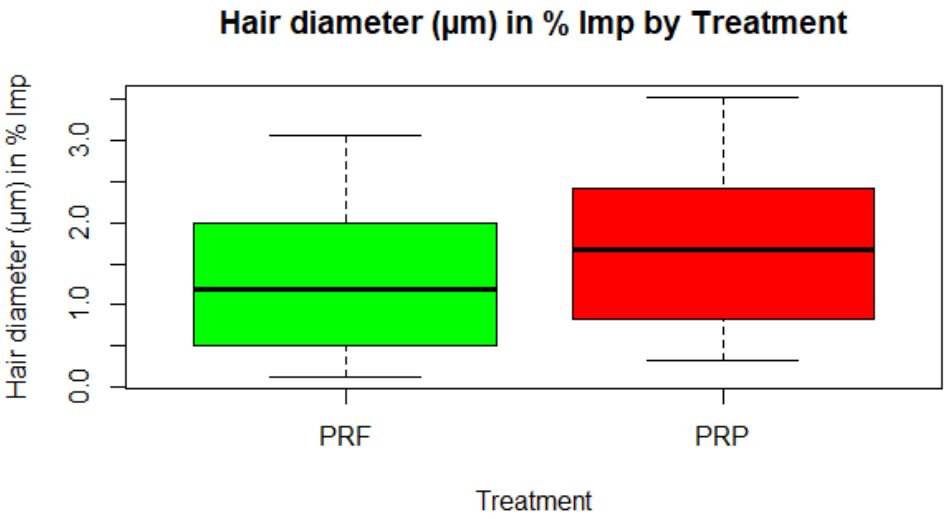


Chart 10b - Box plot of Distribution among Hair Density Improvement by Treatment

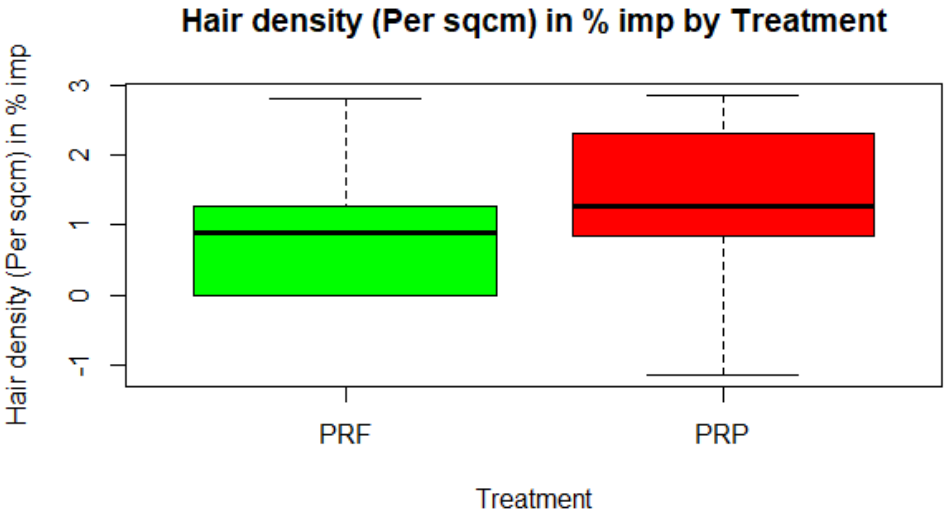


Chart 10c - Box plot of Distribution of Kenogen follicles Improvement by Treatment

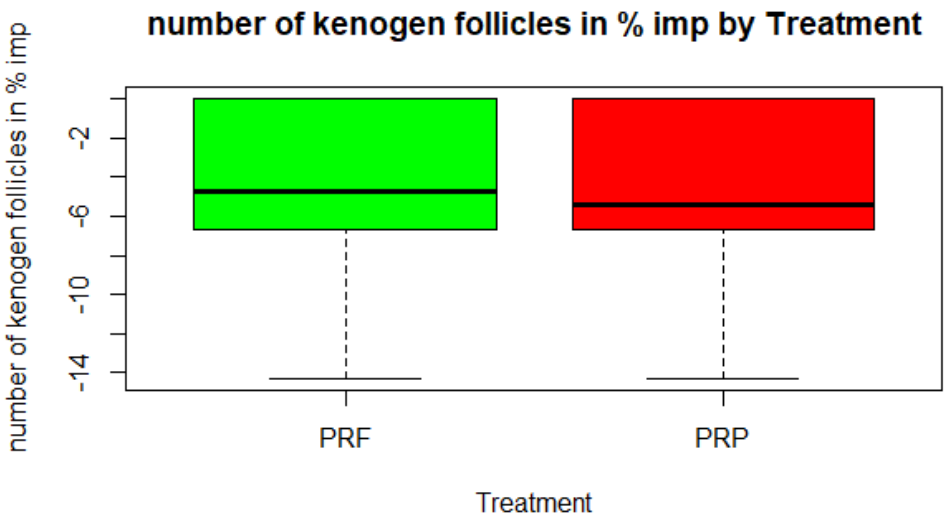


Chart 10d - Box plot of Distribution within Interfollicular distance Improvement by Treatment

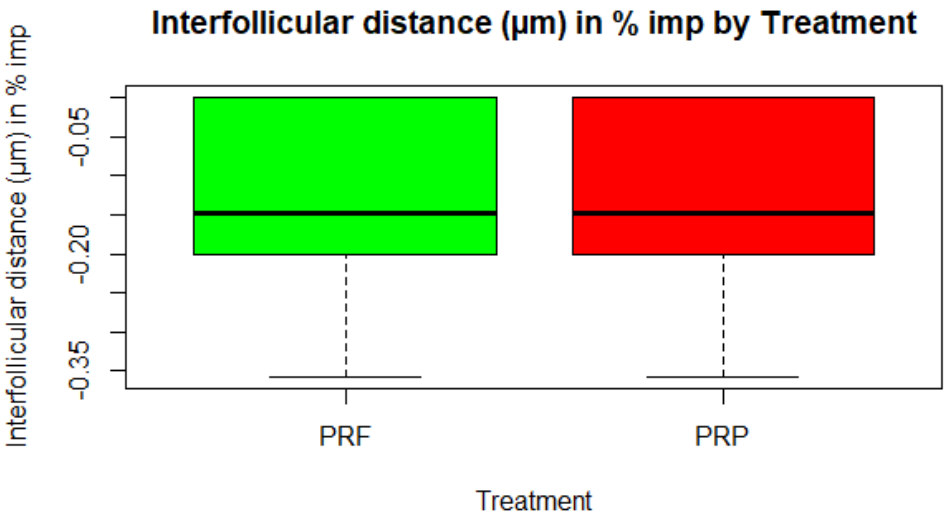


Chart 10e: Box plot of Distribution of hair/ unit follicle Improvement by Treatment

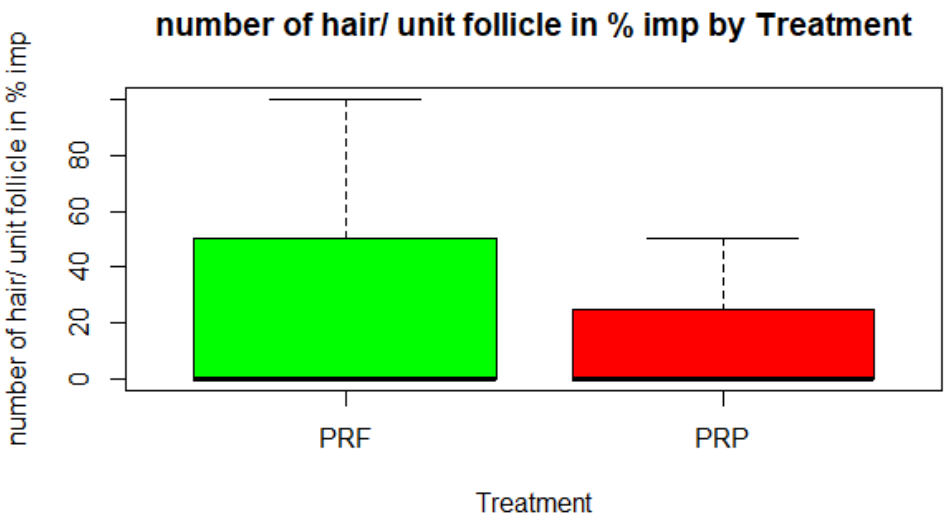


Chart 11a: Mean Bar plot of Hair Diameter Improvement by Treatment

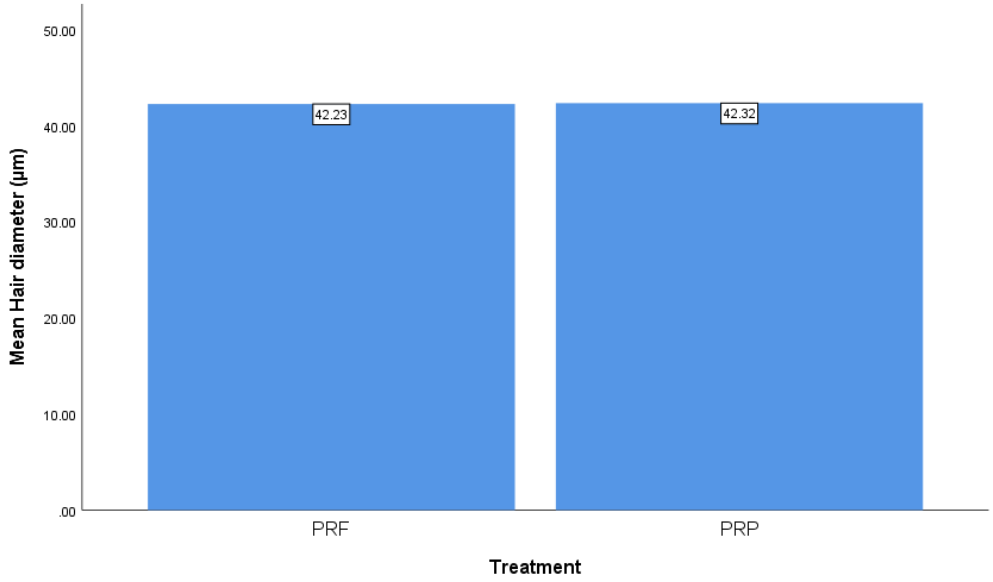


Chart 11b: Mean Bar plot of Hair Density Improvement by Treatment

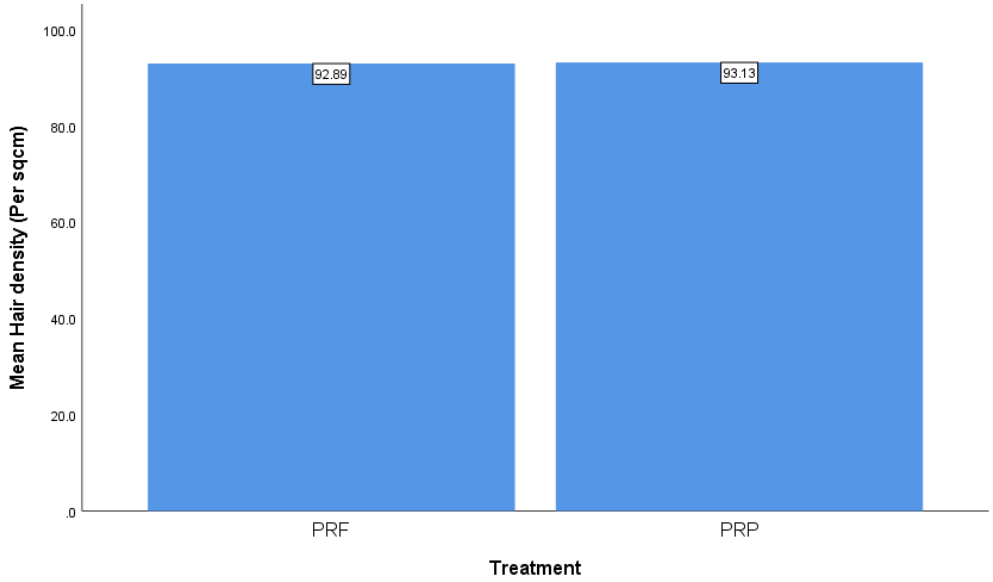


Chart 11c: Mean Bar plot of Kenogen follicles Improvement by Treatment

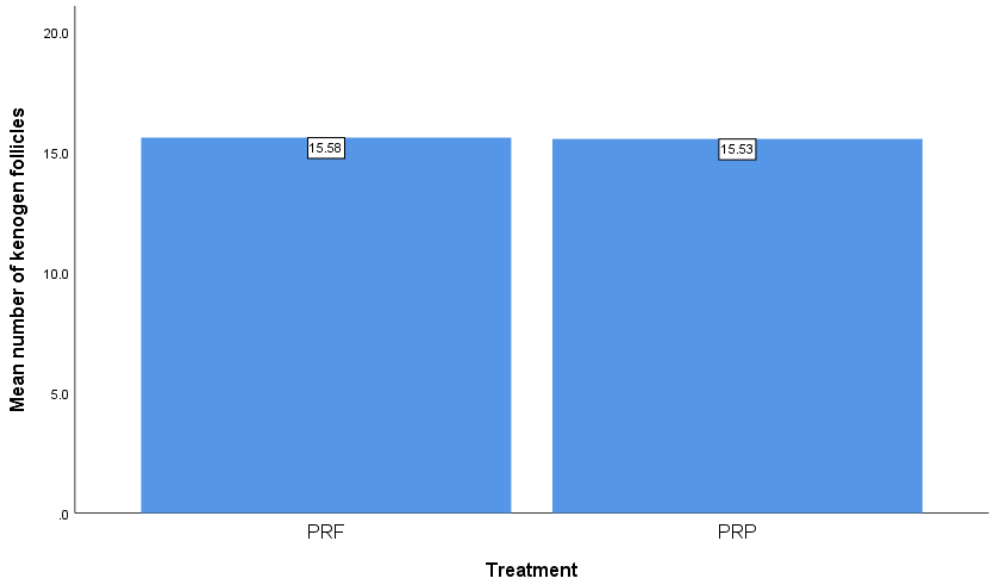


Chart 11d: Mean Bar plot of Interfollicular distance Improvement by Treatment

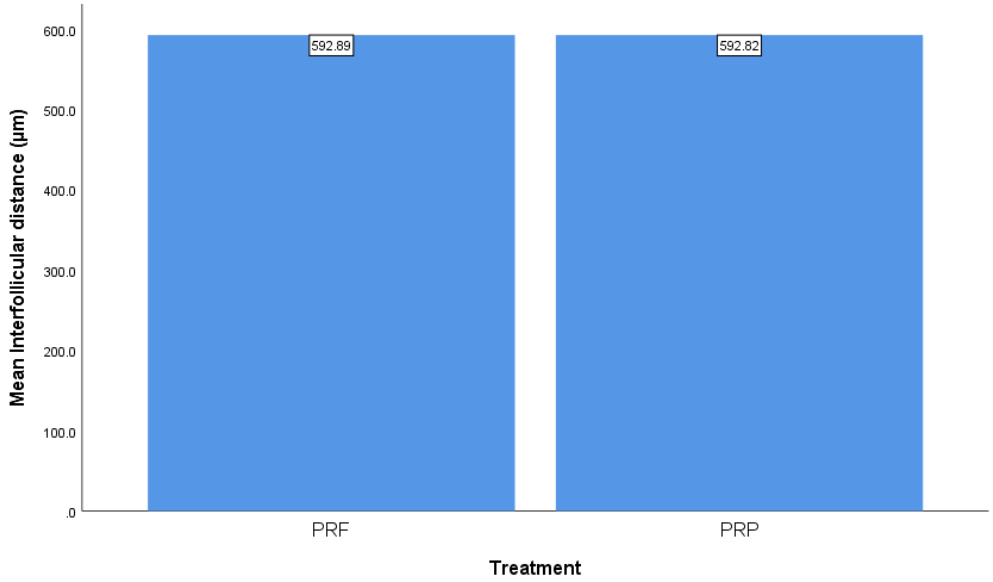
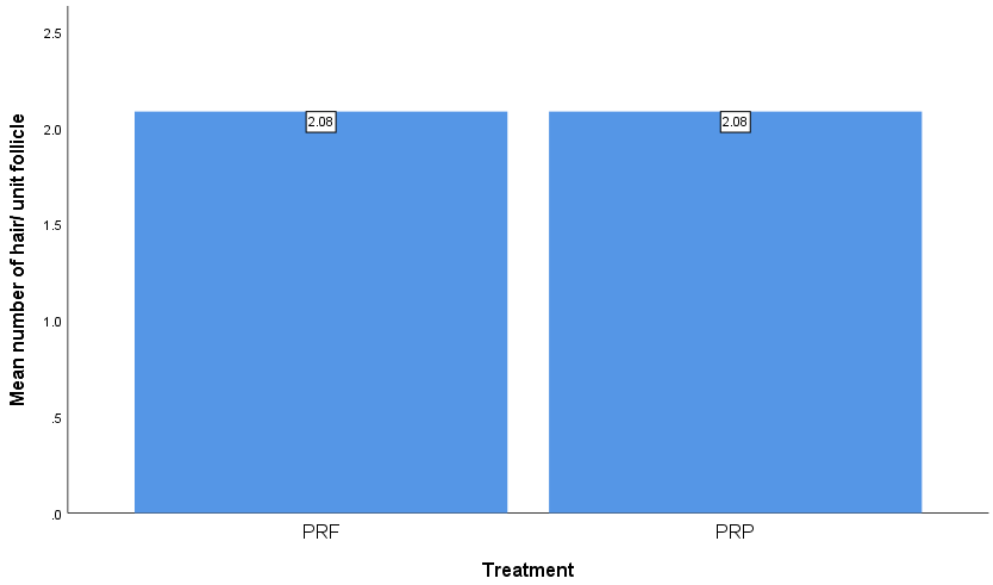


Chart 11e: Mean Bar Plot of hair/ unit follicle Improvement by Treatment



DISCUSSION

This research was carried out as an intervention study within a hospital setting, spanning a duration of 12 months from January 2023 to December 2023. It took place at the Department of Dermatology, Venereology, and Leprosy of KLE'S Dr. Prabhakar Kore Hospital and Medical Research Centre in Belagavi.

36 participants with AGA who satisfied the inclusion criteria were included for participation.

Patients with grade 2 to grade 5 AGA were evaluated. Diagnosis of AGA was made on a clinical basis and classified according to Norwood-Hamilton's hair loss classification[34]. Appropriate photographs were taken both prior to and following treatment with iprf on right side of scalp and PRP on left side and trichoscopy analysis was done using ImageJ software.

The age in our study participants ranged between 18 – 50 years which was similar with the study by Wang et al[35] . The mean age was 33.22 years which is nearly similar to research conducted by Salman et al[36](37.70 years).

Out of the 36 patients recruited, 80.60% (29/36) had a family history of AGA which was comparable with the study done by Mohammad A et al[3] (93.3%).

Within the current analysis, 33.22 years was the mean age recorded of study participants, the mean duration of age was 5.22 years, the mean hair diameter was 42.28, mean hair density was 93.02 hair/ sq cm. Mean quantity of hair per follicle was 2.08, mean inter-follicular distance was 592.85μm. Mean number of empty follicles was 15.56. This is comparable to studies of Bhoite KS et al[1], Michelle V et al[2], Mohammad A et al[3,] and Singh SK et al[4].

Bhoite KS et al[1] pilot study reported dermoscopy findings demonstrated raise within hair per follicular unit, reduction in shaft diameter variability, fall in the number of yellow dots, and an raise in the number of vellus hair which is similar to our study findings.

In current study all the cases were male. Bhoite KS et al[1] pilot case series study evaluating effectiveness, safety characteristics, and practicality of IPRF in treating AGA, found 15 cases of AGA and FPHL of which 12 were males and 3 were females.

The results performed a notable difference in Hair density improvement (p=0.019) between prp & i-prf treatments. Specifically, patients on PRP. This was like study made by Singh SK et al[4].

Grade 4 is the most common with 36.10% ,Grade 2 and Grade 3 each include 25.00% and Grade 5 is the least common at 13.90% . Similar findings were observed by Mohammad A et al[3] and Bhoite KS et al[1].

Our study showed 1.37% increase in density of hair among PRP group and 0.85% increase in iprf group. Mohammad A et al[3] a randomized control trial showed raise by 18% over 3 months on PRP.

Observed in our study that no significant association was found with mean age of cases (33.22) and grading of AGA which was corelating to study done by Chen et al[37]

In the current research, no significant association was found in PRP cases & mean duration of AGA and grades of AGA. These findings were like the studies of Mohamamad A et al[3] and Michelle V et al[2].

Mohamamad A et al[3] study showed stage with the lowest response rate was stage 3 vertex, where only 37.5% of patients showed a positive response. In contrast, the efficacy rate was 100% for stages 1, 3, and 4, stage 5 came as 75% & stage 2 as 83.33%.

In our study, mean hair diameter in PRP cases was42.32 micrometer and mean hair diameter in IPRF cases was 42.23 micrometer. Mean hair density in PRP cases was 91.13 per sq cm and mean hair density in IPRF cases was 93.28 per sq cm. This is similar to research of Singh SK et al[4].

Also observed in study that mean hair per follicle in iprf & PRP cases was 2.08. Mean empty follicles in PRP cases was 15.52 and mean empty follicles in IPRF cases was 15.28. This is comparable to the studies of Mohamamad A et al, Michelle V et al[30], Gupta S et al[38], Khatu SS et al[39], Singh SK et al[40], Masuki H et al[41], Meijia Li et al, Siah TW et al[42], Balasundaram M et al[43] and Arora R et al[29].

LIMITATION:

- Patients with coagulopathy.
- Inflammatory and auto-immune conditions of the scalp like seborrheic dermatitis, scalp psoriasis, alopecia areata, and cicatricial alopecia could not be included.
- the sample size, and
- Duration of follow-up.

CONCLUSION

PRP and I-PRF may be used whenever growth and recovery are needed. The findings demonstrate a statistically notable difference in hair density improvement ($p=0.019$) between two treatments. Especially PRP treatment showed higher improvement in hair density compared to PRF treatment. Nevertheless, other variables did not show significant difference. Sessions can be prolonged to get optimal results. PRF hair regeneration is a relatively recent technique. Perhaps, an increased number of participants and extended follow-up duration of patients additional research is needed to explore the impact of PRF on regeneration of hair.

SUMMARY

The present Interventional study was done on 36 male cases of AGA at our tertiary care center to assess the effectiveness of PRP versus I-PRF in male pattern baldness using trichoscopy and the significance of specific trichoscopy features of AGA. The following observations were noted:

1. The average age of participants involved in the study was 33.22 years, mean duration of AGA was 5.22 years, the mean hair diameter in micrometers was 42.28, and the mean hair density was 93.01hair/sq cm, average quantity of hair per follicle unit was 2.08, and the mean inter-follicular distance was 592.85 µm. Mean number of empty follicles was 15.56.
2. All the cases were male.
3. No significant association was found in age of cases with grade of AGA.
4. No significant association was found regarding mean period of AGA & grades of AGA.
5. Mean hair diameter in PRP cases was 42.32 micrometer and mean hair diameter in IPRF cases was 42.23 micrometer
6. Mean hair density in PRP cases was 93.13 per sq cm and mean hair density in IPRF cases was 92.89 per sq cm
7. Mean hair per follicle unit within PRP cases was 3.5 and Mean hair per follicle among IPRF cases was 1.78
8. Mean empty follicles in PRP cases was 15.52 and mean empty follicles in IPRF cases was 15.58

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ANNEXURE I –

INFORMED CONSENT FORM

Title of the study: **"PRP versus I-PRF in the treatment of male pattern baldness. A split scalp interventional study" attending KLE's Dr Prabhakar Kore Hospital & MRC, Belagavi**

Respected Sir/Madam,

We invite you to participate in our study as you are eligible for the same. During the study you will be asked some questions in detail regarding your present complaints.

Purpose of the study:

To know the effectiveness of PRP versus I-PRF in male pattern baldness.

Explanation of procedure: all clinically diagnosed patients of androgenetic alopecia who fulfill the inclusion criteria will be evaluated with detailed history and trichoscopy. The data will be recorded in the form of questionairre and images will be stored. All patients with androgenetic alopecia attending KLE`S Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi will be recruited. Informed consent will be taken from all the patients included in the study. All patients in the study will undergo a detailed history taking, general physical, systemic and dermatological examination. In this study, 4 treatment sessions of Platelet rich plasma injection on left side of the scalp and Injectable-platelet rich fibrin on right side of the scalp at 4 weeks interval will be done in patients with androgenetic alopecia. High resolution digital photographs will be taken of the scalp using identical camera settings, patients positioning and room lighting at the baseline and at every sitting. Data will be collected by a single examiner and recorded in case record

proforma. Records will be maintained and analyzed statistically. Under all aseptic precautions, 30 mL of whole venous blood is withdrawn from antecubital vein via scalp vein catheter. 24ml is collected into two sterile conical bottom centrifuge plastic tubes that is 12ml in each tube. No anticoagulant is added to the tubes for I-PRF. The tubes are then immediately placed diametrically opposite to each other inside the centrifuge fitted with bucket-handle/swing-out handle type of rotor (RemiR4c model) , and centrifuged at 800 rpm for 4 minutes. The tubes are removed and the upper yellow-orange-coloured liquid obtained is injectable PRF. I-PRF is filled in insulin syringe. Right side of the scalp will receive intradermal I-PRF injection. PRP will be prepared by collecting 6ml of blood in three vials having Anticoagulant 3.2% sodium citrate in BD Vacutainer (BD Company, Bangalore, India) blood collection tubes, that is 2ml in each tube. Sodium citrate vials will be used to inhibit platelet aggregation. It will then be centrifuged by double-spin method. Soft spin is for 6 min at 1500 rotations per minute. Now, separate PPP with buffy coat in plane vacutainer without anti-coagulant and centriguge at 2500 RPM for 15mins (hard spin). The product thus obtained is filled in insulin syringes and used. The left side of the scalp will receive intradermal PRP injection. Process will be repeated every 4 weeks. Post procedure care is explained as follows: Wash the scalp with a Wear the sterile cap for at least 3 hours after post procedure. Do not wet the site of injection for at least 24 hours after the procedure. Do not opt for any parlour treatments for next 2 weeks or thereafter without consulting the doctor. A good diet, adequate water intake and adequate sleep will ensure better healing and good response. Attend the next session on the date, as advised by the treating doctor, in order to get the desired result. At the end of 4 weeks digital photographs will be taken at same angle to compare with baseline photographs and regrading of Norwood and Hamilton classification will be done for comparison with the baseline score. Physician’s assessment will be classified as

excellent, good, and poor. The improvement will be rated as poor, good, and excellent depending on the change in grade of acne scars by both treating physician and the patient. Patients' perceptions of improvement will be noted by using the visual analogue scale, where the patient was asked to mark on the line the point that they feel represents their perception of their current state.

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions regarding this study, you are free to contact: Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights. Voluntary participation:

Your participation in this study is voluntary. Your decision whether or not to participate will neither affect the care of your current disease, nor your future relations with the doctor or the hospital. In the event if you suffer any physical injury as the result of your participation in this study, you may please contact Dr. Harsha Hegde, chairman of the ethical committee, J N Medical College, Belagavi. 9480422500

STATEMENT OF CONSENT

I.D.NO: | | | |

I am making a voluntary decision to participate in the study "PRP versus I-PRF in the treatment of male pattern baldness. a split scalp interventional study". My signature below indicates that I have decided to participate, and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

Date: | | | |

ANNEXURE II –

PROFORMA

TITLE : "Platelet rich plasma versus injectable-platelet rich fibrin in the treatment of male pattern baldness – A split scalp interventional study"

Name :

Case No :

Age :

Gender:

Date :

Address with phone number :

Occupation:

Chief Complaint :

Duration:

Preceding Symptoms before onset of AGA: ☐ Present ☐ Absent

Mention (If any) :

MEDICAL HISTORY

- **Does the patient have been diagnosed as suffering from any disease? ☐ Yes ☐ No**

  if Yes, specify _____

- **Does the patient have any history of allergies? ☐ Yes ☐ No**

  if Yes, specify _____

- **Does the patient have been submitted to any surgery? ☐ Yes ☐ No**

  if Yes, specify _____

- **Does the patient smoke? ☐ Yes ☐ No**

  if Yes, specify quantity/day _____

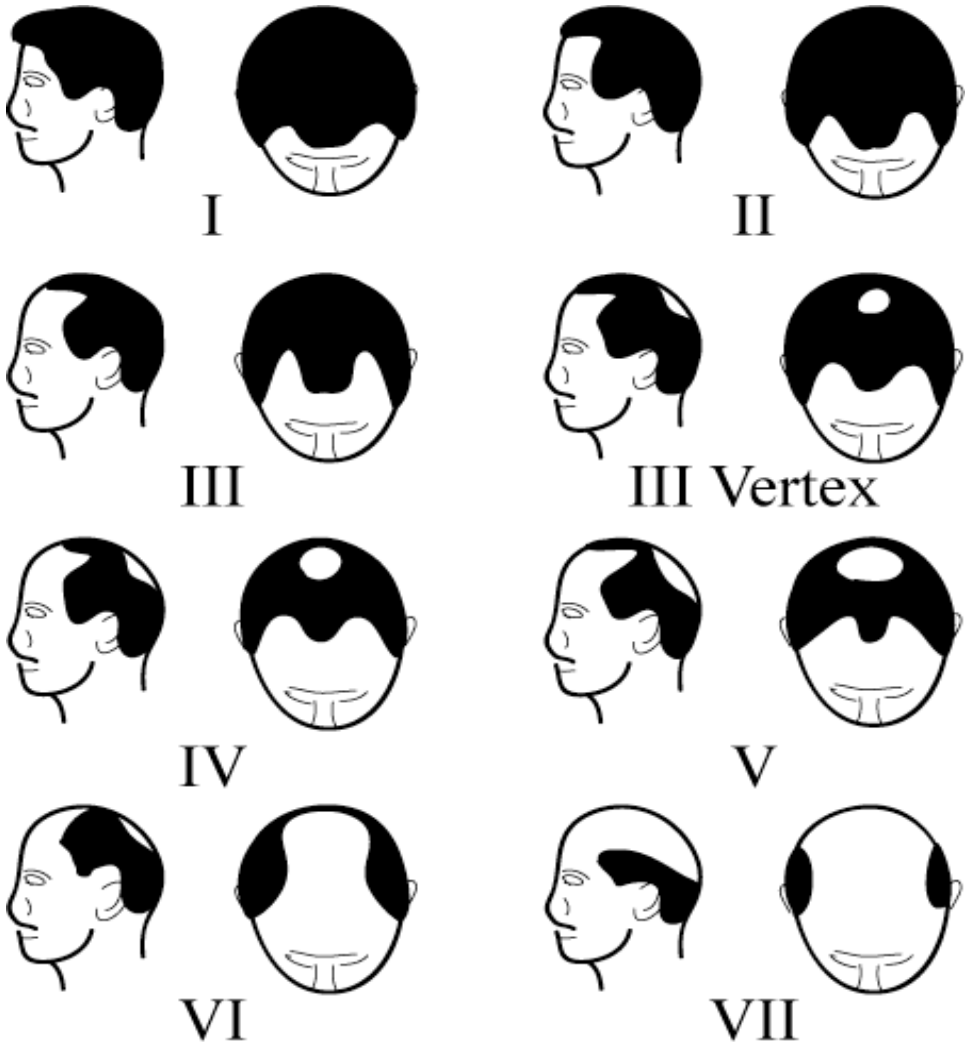
- **Does the patient take any medication? ☐ Yes ☐ No**

  If Yes, specify _____

ANDROGENIC ALOPECIA (AGA) HISTORY AND DESCRIPTION

- **How old was your patient when his AGA started? __ years**

- **Localization and Stage: Please, indicate the stage of AGA corresponding to your patient according to the Norwood<Hamilton classification below: ___**



- **Does your patient have family history of AGA? Yes No**
  if Yes, specify _____

MEDICAL CARE FOR AGA

- **Does your patient take any oral treatment for his alopecia? Yes No**

  If yes, please specify _____

- **Does your patient take dietary supplements for his alopecia? Yes No**

  If yes, please specify _____

- **Does your patient take topical treatment for his alopecia? Yes No**

  If yes, please specify _____

- **Does your patient take other treatment for his alopecia? Yes No**

  If yes, please specify _____

STANDARDIZED IMAGES (PHOTOS)

Please take standardized images of the 3 areas mentioned below:

1.Vertex 2. Frontal 3.Temporal

STANDARDIZED TRICHOSCOPY: Please take standardized images of the 4 areas mentioned below:

Frontal right Frontal left

Vertex right Vertex left

These images will be compared with those taken at the next visit.

INFILTRATION PRP:

Frontal right Frontal left

Vertex right Vertex left

INFILTRATION I-PRF SOLUTION:

Frontal right Frontal left

Vertex right Vertex left

PATIENT FEELING ABOUT GLOBAL IMPROVEMENT

Is the patient satisfied with the effectiveness of the treatment?

0-Not satisfied

1-Slightly satisfied

2-Very satisfied

3-Extremely satisfied.

PHYSICIAN FEELING ABOUT GLOBAL IMPROVEMENT Are you satisfied with the effectiveness of the treatment?

0-Not satisfied

1-Slightly satisfied

2-Very satisfied

3-Extremely satisfied.

ANNEXURE III – PHOTOGRAPHS

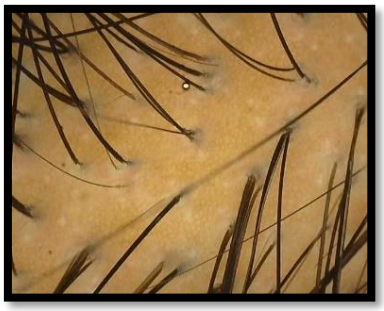


Figure 1a

Figure 1b

Figure 1c

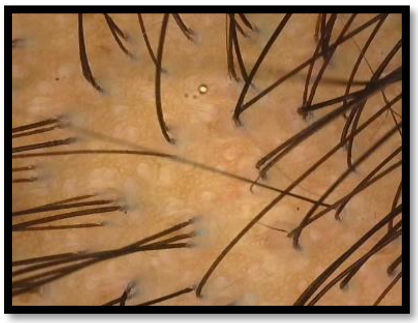


Figure 1d

Figure 1a-d: (a) Trichoscopic images of vertex area of scalp before PRP treatment; (b) trichoscopic images of vertex area of scalp after PRP treatment; (c) Trichoscopic images of vertex area of scalp before I-PRF treatment; (d) Trichoscopic images of vertex area of scalp after I-PRF treatment.

Figure 2a

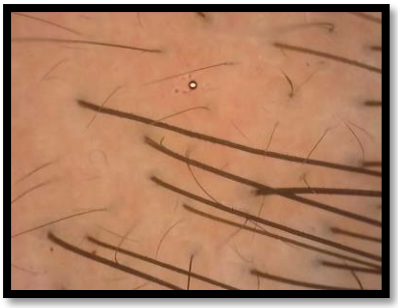


Figure 2b

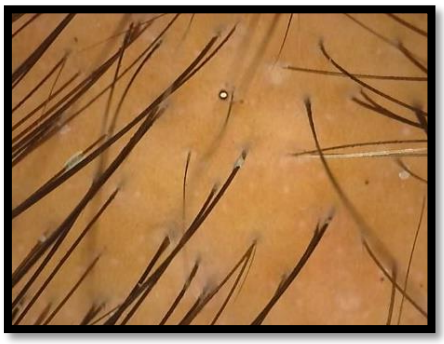


Figure 2c

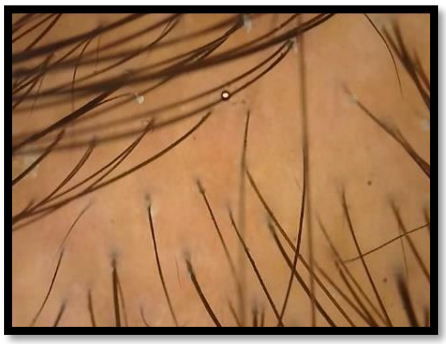


Figure 2d

Figure 2a-2c: (a) Trichoscopic image of frontal area of scalp before PRP treatment; (b) Trichoscopic image of frontal area of scalp after PRP; (c) Trichoscopic image of frontal area of scalp before I-PRF treatment; (d) Trichoscopic image of frontal area of scalp after I-PRF treatment.

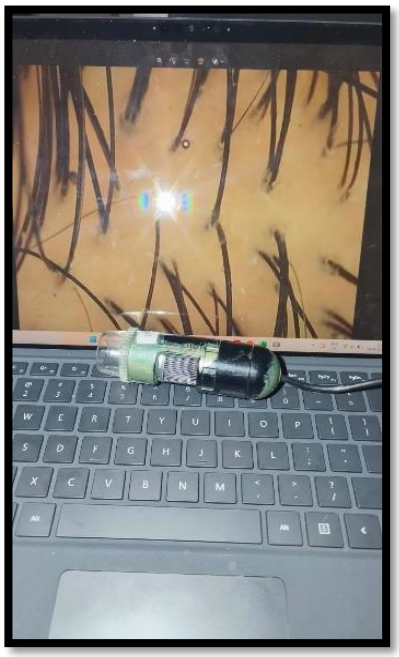


Figure 3a

Figure 3b

Figure 3a & 3b: (a)Trichoscopy; (b)Trichoscopic image taken with the hand-held digital microscope connected to a laptop computer as a portable trichoscope: Dino-Lite AM4113ZT USB Digital Microscope, 1280 x 1024 pixels, 200X Magnification.

Figure 4 : Centrifuge machine : REMI R-8C

Figure 5a

Figure 5b

Figure 5c

Figure 5a-5c : (a)Plastic 15 mL centrifuge tube; (b)3.2% sodium citrate vacutainers; (c)Insulin syringe for injection.

ANNEXURE IV – KEY TO MASTER CHART

PRP – PLATELET RICH PLASMA

I-PRF – INJECTABLE PLATELET RICH FIBRIN

VAS – VISUAL ANALOGUE SCALE

ANNEXURE V – MASTER CHART

Sl. No.	AGE	GENDER	occupation	married	family history	Duration of AGA in years	Grade	SESSIONS	Hair diameter (µm) in PRP				Hair diameter (µm) in I-PRF				Hair density (Per sqcm) in PRP				Hair density (Per sqcm) in I-PRF			
									Session 1	session 4	average	% Imp	Session 1	session 4	average	% Imp	session 1	session 4	average	% imprv	session 1	session 4	average	% imp
1	24	Male	student	no	yes	5	2	4	46.29	46.60	46.45	0.67%	46.29	46.6	46.45	0.67%	74	76	75	2.70%	74	74	74	0.00%
2	34	Male	clerical	yes	yes	6	4	4	41.21	41.41	41.31	0.49%	41.21	41.41	41.31	0.49%	73	74	73.5	1.37%	73	74	73.5	1.37%
3	34	Male	agriculturyes	yes	yes	5	4	4	39.64	39.90	39.77	0.66%	39.64	39.69	39.67	0.13%	71	71	71	0.00%	71	72	71.5	1.41%
4	28	Male	student	yes	yes	4	3	4	41.32	41.77	41.55	1.09%	41.32	41.49	41.41	0.41%	89	91	90	2.25%	89	89	89	0.00%
5	40	Male	food servyes	yes	yes	7	4	4	40.77	41.10	40.94	0.81%	40.77	40.92	40.85	0.37%	87	87	87	0.00%	87	88	87.5	1.15%
6	27	Male	delivery	yes	yes	3	3	4	42.24	42.87	42.56	1.49%	42.24	42.66	42.45	0.99%	84	86	85	2.38%	84	86	85	2.38%
7	44	Male	agriculturyes	yes	yes	6	5	4	39.88	40.11	40.00	0.58%	39.88	40.05	39.97	0.43%	120	121	120.5	0.83%	120	121	120.5	0.83%
8	21	Male	student	no	yes	5	2	4	45.76	46.15	45.96	0.85%	45.76	45.94	45.85	0.39%	111	114	112.5	2.70%	111	112	111.5	0.90%
9	32	Male	clerical	yes	yes	8	4	4	40.53	41.66	41.10	2.79%	40.53	41.11	40.82	1.43%	116	119	117.5	2.59%	116	116	116	0.00%
10	34	Male	agriculturyes	yes	yes	9	5	4	34.91	35.03	34.97	0.34%	34.91	35.08	35.00	0.49%	120	123	121.5	2.50%	120	121	120.5	0.83%
11	35	Male	food servyes	no	yes	2	3	4	42.39	42.86	42.63	1.11%	42.39	42.76	42.58	0.87%	76	78	77	2.63%	76	76	76	0.00%
12	46	Male	clerical	yes	no	4	4	4	40.13	40.89	40.51	1.89%	40.13	40.72	40.43	1.47%	78	79	78.5	1.28%	78	79	78.5	1.28%
13	37	Male	delivery	yes	no	5	4	4	39.98	40.11	40.05	0.33%	39.98	40.1	40.04	0.30%	79	81	80	2.53%	79	80	79.5	1.27%
14	27	Male	student	no	yes	7	4	4	41.13	41.88	41.51	1.82%	41.13	41.71	41.42	1.41%	89	90	89.5	1.12%	89	89	89	0.00%
15	25	Male	student	no	yes	2	2	4	46.26	47.49	46.88	2.66%	46.26	47.41	46.84	2.49%	87	88	87.5	1.15%	87	88	87.5	1.15%
16	28	Male	delivery	no	yes	7	4	4	39.80	40.52	40.16	1.81%	39.80	40.42	40.11	1.56%	88	87	87.5	-1.14%	88	89	88.5	1.14%
17	24	Male	student	no	yes	4	3	4	42.30	42.89	42.60	1.39%	42.30	42.69	42.50	0.92%	87	88	87.5	1.15%	87	88	87.5	1.15%
18	21	Male	student	no	yes	5	2	4	46.47	47.04	46.76	1.23%	46.47	46.98	46.73	1.10%	79	80	79.5	1.27%	79	80	79.5	1.27%
19	34	Male	engineer	yes	yes	6	4	4	40.89	41.08	40.99	0.46%	40.89	41.11	41.00	0.54%	70	72	71	2.86%	70	70	70	0.00%
20	47	Male	agriculturyes	yes	yes	5	3	4	42.41	43.88	43.15	3.47%	42.41	43.67	43.04	2.97%	114	116	115	1.75%	114	115	114.5	0.88%
21	34	Male	engineer	yes	yes	4	3	4	41.89	42.06	41.98	0.41%	41.89	41.01	41.45	-2.10%	115	117	116	1.74%	115	116	115.5	0.87%
22	28	Male	student	yes	yes	6	3	4	42.42	43.88	43.15	3.44%	42.42	43.72	43.07	3.06%	117	118	117.5	0.85%	117	117	117	0.00%
23	41	Male	agriculturyes	no	yes	6	4	4	41.02	41.89	41.46	2.12%	41.02	41.78	41.40	1.85%	121	121	121	0.00%	121	123	122	1.65%
24	34	Male	engineer	yes	no	6	4	4	40.76	41.43	41.10	1.64%	40.76	41.26	41.01	1.23%	74	75	74.5	1.35%	74	74	74	0.00%
25	38	Male	delivery	yes	no	5	3	4	42.36	43.67	43.02	3.09%	42.36	43.62	42.99	2.97%	73	74	73.5	1.37%	73	74	73.5	1.37%
26	40	Male	clerical	yes	yes	7	5	4	39.56	40.53	40.05	2.45%	39.56	40.31	39.94	1.90%	71	73	72	2.82%	71	73	72	2.82%
27	27	Male	student	no	yes	2	2	4	46.76	47.72	47.24	2.05%	46.76	47.11	46.94	0.75%	89	91	90	2.25%	89	90	89.5	1.12%
28	22	Male	student	no	yes	4	2	4	47.21	48.39	47.80	2.50%	47.21	48.21	47.71	2.12%	87	88	87.5	1.15%	87	87	87	0.00%
29	45	Male	agriculturyes	no	yes	6	5	4	39.81	40.63	40.22	2.06%	39.81	40.52	40.17	1.78%	88	89	88.5	1.14%	88	88	88	0.00%
30	32	Male	engineer	yes	yes	5	2	4	45.82	46.71	46.27	1.94%	45.82	46.82	46.32	2.18%	87	87	87	0.00%	87	88	87.5	1.15%
31	34	Male	engineer	yes	yes	2	2	4	46.34	47.63	46.99	2.78%	46.34	47.45	46.90	2.40%	79	80	79.5	1.27%	79	79	79	0.00%
32	35	Male	agriculturyes	yes	yes	7	4	4	40.65	41.23	40.94	1.43%	40.65	41.12	40.89	1.16%	70	70	70	0.00%	70	71	70.5	1.43%
33	39	Male	clerical	yes	yes	4	3	4	41.42	42.88	42.15	3.52%	41.42	42.58	42.00	2.80%	114	115	114.5	0.88%	114	114	114	0.00%
34	37	Male	clerical	yes	yes	6	4	4	40.81	41.50	41.16	1.69%	40.81	41.35	41.08	1.32%	115	115	115	0.00%	115	116	115.5	0.87%
35	27	Male	student	no	yes	5	2	4	42.89	43.91	43.40	2.38%	42.89	43.78	43.34	2.08%	117	118	117.5	0.85%	117	117	117	0.00%
36	41	Male	clerical	yes	yes	8	5	4	36.69	37.01	36.85	0.87%	36.69	36.89	36.79	0.55%	121	123	122	1.65%	121	124	122.5	2.48%

hair diameter diversity in PRP		hair diameter diversity in I-PRF		number of keragen follicles in PRP				Number of keragen follicles in I-PRF				Interfollicular distance (µm) in PRP				Interfollicular distance in I-PRF				number of hair/ unit follicle in PRP				number of hair/ unit follicle in I-PRF				VAS Satisfaction		some ent Dermatologists in	
session 1	session 4	session 1	session 4	session 1	session 4	average	% imp	session 1	session 4	average	% imp	session 1	session 4	average	% imp	session 1	session 4	average	% imp	session 1	session 4	average	% imp	session 1	session 4	average	% imp	PRP	I-PRF	prp	I prf
Present	Present	Present	Present	10	8	9	-20.00%	10	9	9.5	-10.00%	500	500	500	0.00%	500	500	500	0.00%	3	3	3	0.00%	3	3	3	0.00%	0.00%	0	1	1
Present	Present	Present	Present	14	14	14	0.00%	14	14	14	0.00%	598	590	594	-1.34%	598	590	594	-1.34%	2	2	2	0.00%	2	2	2	0.00%	0.00%	1	0	2	0
Present	Present	Present	Present	15	13	14	-13.33%	15	14	14.5	-6.67%	623	622	622.5	-0.16%	623	622	622.5	-0.16%	3	3	3	0.00%	3	3	3	0.00%	0.00%	2	0	0	1
Present	Present	Present	Present	17	16	16.5	-5.88%	17	16	16.5	-5.88%	478	478	478	0.00%	478	478	478	0.00%	2	2	2	0.00%	2	2	2	0.00%	0.00%	1	0	1	1
Present	Present	Present	Present	18	17	17.5	-5.56%	18	18	18	0.00%	654	654	654	0.00%	654	654	654	0.00%	1	2	1.5	100.00%	1	2	1.5	100.00%	100.00%	0	0	0	1
Present	Present	Present	Present	20	19	19.5	-5.00%	20	19	19.5	-5.00%	696	696	696	0.00%	696	696	696	0.00%	2	2	2	0.00%	2	2	2	0.00%	0.00%	1	0	1	1
Present	Present	Present	Present	21	21	21	0.00%	21	21	21	0.00%	589	589	589	0.00%	589	589	589	0.00%	1	2	1.5	100.00%	1	2	1.5	100.00%	100.00%	0	0	0	1
Present	Present	Present	Present	14	14	14	0.00%	14	14	14	0.00%	498	498	498	0.00%	498	498	498	0.00%	2	3	2.5	50.00%	2	3	2.5	50.00%	50.00%	1	0	0	0
Present	Present	Present	Present	16	15	15.5	-6.25%	16	15	15.5	-6.25%	669	669	669	0.00%	669	669	669	0.00%	3	3	3	0.00%	3	3	3	0.00%	0.00%	1	1	0	0
Present	Present	Present	Present	17	17	17	0.00%	17	17	17	0.00%	479	471	475	-1.67%	479	475	477	-0.84%	2	2	2	0.00%	2	2	2	0.00%	0.00%	1	1	1	1
Present	Present	Present	Present	18	17	17.5	-5.56%	18	17	17.5	-5.56%	532	531	531.5	-0.19%	532	531	531.5	-0.19%	2	3	2.5	50.00%	2	3	2.5	50.00%	50.00%	0	1	0	2
Present	Present	Present	Present	18	18	18	0.00%	18	18	18	0.00%	549	548	548.5	-0.18%	549	548	548.5	-0.18%	2	2	2	0.00%	2	2	2	0.00%	0.00%	1	1	1	0
Present	Present	Present	Present	12	11	11.5	-8.33%	12	11	11.5	-8.33%	671	670	670.5	-0.15%	671	670	670.5	-0.15%	2	2	2	0.00%	2	2	2	0.00%	0.00%	2	0	0	1
Present	Present	Present	Present	13	13	13	0.00%	13	13	13	0.00%	543	542	542.5	-0.18%	543	542	542.5	-0.18%	3	3	3	0.00%	3	3	3	0.00%	0.00%	0	0	0	1
Present	Present	Present	Present	11	11	11	0.00%	11	11	11	0.00%	687	686	686.5	-0.15%	687	686	686.5	-0.15%	2	2	2	0.00%	2	2	2	0.00%	0.00%	1	0	0	1
Present	Present	Present	Present	15	13	14	-13.33%	15	13	14	-13.33%	667	666	666.5	-0.15%	667	666	666.5	-0.15%	3	3	3	0.00%	3	3	3	0.00%	0.00%	0	0	1	0
Present	Present	Present	Present	14	12	13	-14.29%	14	12	13	-14.29%	497	493	495	-0.80%	497	493	495	-0.80%	2	2	2	0.00%	2	2	2	0.00%	0.00%	1	1	1	0
Present	Present	Present	Present	16	15	15.5	-6.25%	16	16	16	0.00%	548	544	546	-0.73%	548	544	546	-0.73%	2	3	2.5	50.00%	2	3	2.5	50.00%	50.00%	1	0	1	0
Present	Present	Present	Present	17	17	17	0.00%	17	17	17	0.00%	631	631	631	0.00%	631	631	631	0.00%	1	3	2	200.00%	1	2	1.5	100.00%	100.00%	0	0	1	0
Present	Present	Present	Present	18	18	18	0.00%	18	18	18	0.00%	542	542	542	0.00%	542	542	542	0.00%	2	2	2	0.00%	2	2	2	0.00%	0.00%	0	0	0	0
Present	Present	Present	Present	10	8	9	-20.00%	10	8	9	-20.00%	549	549	549	0.00%	549	549	549	0.00%	1	1	1	0.00%	1	1	1	0.00%	0.00%	0	0	1	2
Present	Present	Present	Present	14	13	13.5	-7.14%	14	13	13.5	-7.14%	654	652	653	-0.31%	654	652	653	-0.31%	2	2	2	0.00%	2	2	2	0.00%	0.00%	1	0	0	1
Present	Present	Present	Present	15	14	14.5	-6.67%	15	14	14.5	-6.67%	678	677	677.5	-0.15%	678	677	677.5	-0.15%	1	1	1	0.00%	1	1	1	0.00%	0.00%	1	1	1	1
Present	Present	Present	Present	17	16	16.5	-5.88%	17	16	16.5	-5.88%	689	689	689	0.00%	689	689	689	0.00%	3	3	3	0.00%	3	3	3	0.00%	0.00%	1	0	0	1
Present	Present	Present	Present	18	17	17.5	-5.56%	18	17	17.5	-5.56%	489	483	486	-1.23%	489	483	486	-1.23%	2	2	2	0.00%	2	2	2	0.00%	0.00%	0	0	0	1
Present	Present	Present	Present	20	20	20	0.00%	20	20	20	0.00%	590	590	590	0.00%	590	590	590	0.00%	2	3	2.5	50.00%	2	2	2	0.00%	0.00%	1	0	0	1
Present	Present	Present	Present	21	21	21	0.00%	21	21	21	0.00%	698	696	697	-0.29%	698	696	697	-0.29%	3	3	3	0.00%	3	3	3	0.00%	0.00%	0	0	0	1
Present	Present	Present	Present	17	17	17	0.00%	17	17	17	0.00%	592	591	591.5	-0.17%	592	592	592	0.00%	2	2	2	0.00%	2	2	2	0.00%	0.00%	2	0	0	0
Present	Present	Present	Present	19	18	18.5	-5.26%	19	18	18.5	-5.26%	664	664	664	0.00%	664	664	664	0.00%	1	1	1	0.00%	1	2	1.5	100.00%	100.00%	1	0	0	0
Present	Present	Present	Present	21	18	19.5	-14.29%	21	18	19.5	-14.29%	654	654	654	0.00%	654	654	654	0.00%	2	2	2	0.00%	2	3	2.5	50.00%	50.00%	0	1	1	0
Present	Present	Present	Present	22	21	21.5	-4.55%	22	21	21.5	-4.55%	678	677	677.5	-0.15%	678	677	677.5	-0.15%	2	2	2	0.00%	2	2	2	0.00%	0.00%	0	1	1	1
Present	Present	Present	Present	15	14	14.5	-6.67%	15	14	14.5	-6.67%	560	558	559	-0.36%	560	558	559	-0.36%	1	1	1	0.00%	1	1	1	0.00%	0.00%	0	1	1	1
Present	Present	Present	Present	11	11	11	0.00%	11	11	11	0.00%	470	469	469.5	-0.21%	470	469	469.5	-0.21%	2	2	2	0.00%	2	2	2	0.00%	0.00%	0	0	0	0
Present	Present	Present	Present	13	13	13	0.00%	13	13	13	0.00%	532	531	531.5	-0.19%	532	531	531.5	-0.19%	1	2	1.5	100.00%	1	2	1.5	100.00%	100.00%	1	1	0	0
Present	Present	Present	Present	11	11	11	0.00%	11	11	11	0.00%	543	542	542.5	-0.18%	543	542	542.5	-0.18%	2	2	2	0.00%	2	3	2.5	50.00%	50.00%	0	0	0	0
Present	Present	Present	Present	15	14	14.5	-6.67%	15	14	14.5	-6.67%	675	675	675	0.00%	675	675	675	0.00%	1	2	1.5	100.00%	1	1	1	0.00%	0.00%	1	0	0	0