Management of Androgenetic Alopecia

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Overview

- Embryology and Anatomy of Hair
- Androgenetic Alopecia
- Hair Growth Cycle
- Pathophysiology of Hair Loss
- Patient Evaluation
- Medical Treatment
- Surgical Treatment
  - Historical
  - Follicular Unit Transplantation
Embryology and Anatomy of Hair
Embryology of Hair Follicle

• Begin development between 9 and 12 weeks gestational age
• Hair production typically seen between 16 and 20 weeks gestational age
Embryology of Hair Follicle

- Derived from ectoderm and mesoderm
  - Ectoderm
    - Hair matrix cells
    - Melanocytes
  - Mesoderm
    - Erector pili
    - Dermal papilla
    - Follicular sheath
    - Blood vessels
Anatomy of Hair Shaft

- Surrounded by an outer and inner sheath
- Shaft composed of 3 layers
  - Cuticle: outer layer
  - Cortex: middle layer
  - Medulla: inner layer
Follicular Unit

- Terminal hairs: 1-4
- Vellus hairs: 1-2
- Sebaceous glands: 9
- Erector pili muscle: 9
- Perifollicular vascular plexus
- Neural net
- Connective tissue
SCALP Layers

- Skin
- Connective tissue (subcutaneous tissue)
- Aponeurotica (galea aponeurotica)
- Loose connective tissue
- Pericranium
Blood Supply and Innervation

- Frontal
  - Supratrochlear
  - Supraorbital
- Temporal
  - Superficial temporal
  - Zygomaticotemporal
- Parietal
  - Retroauricular
  - Auriculotemporal, Great auricular, Lesser occipital
- Occipital
  - Occipital
  - Greater occipital
Alopecia
Alopecia

• Definition:
  – Origin: Gr. Alepeokia = a disease in which the hair falls out
  – Loss of hair, wool, or feathers
  – Absence of hair from skin areas where it is normally present
Types of Alopecia

- Alopecia adnata
- Alopecia areata
- Alopecia cicatrisata
- Alopecia congenitalis
- Alopecia disseminata
- Alopecia leprotica
- Alopecia marginalis
- Alopecia medicamentosa
- Alopecia mucinosa
- Alopecia pityrodes
- Alopecia presinilis
- Alopecia senilis
- Alopecia symptomatica
- Alopecia syphilitica
- Alopecia totalis
- Alopecia toxica
- Alopecia triangularis
- Alopecia triangularis congenitalis
- Alopecia universalis
Androgenetic Alopecia

• Definition
  – Hereditary thinning of the hair induced by androgens in genetically susceptible men and women

• Also known as
  – Male-pattern hair loss or common baldness in men
  – Female-pattern hair loss in women
Androgenetic Alopecia

- Thinning of hair usually begins between 12 and 40 years old in males and females.
- Approximately half the population expresses this trait to some degree before age 50.
- Inheritance is polygenic.
Hair Growth Cycle
Hair Growth Cycle

• Stages
  – Anagen = growth
  – Catagen = involution
  – Telogen = rest
Hair Growth Cycle

• Normal scalp activity
  – Anagen = 90-95%
  – Catagen = <1%
  – Telogen = 5-10%

• At the end of telogen, hair is released and the next cycle is initiated

• Up to 100 hairs in telogen are shed each day and about the same number of follicles enter anagen
Hair Growth Cycle

- **ANAGEN**: 90% of hairs
- **CATAGEN**: 1-2 weeks
- **TELOGEN**: 10% of hairs
- **EARLY ANAGEN**: New hair
Pathophysiology of Hair Loss
Pathophysiology of Hair Loss

• Dihydrotestosterone
  – Formed by peripheral conversion of testosterone by 5-alpha reductase
  – Binds to androgen receptor on susceptible hair follicles

• Hormone-receptor complex activates genes responsible for gradual transformation of large terminal follicles to miniaturized follicles
Pathophysiology of Hair Loss: Miniaturization
Pathophysiology of Hair Loss: Miniaturization

• Progressive diminution of hair shaft diameter and length in response to systemic androgens
Patient Evaluation
Patient Evaluation

• Androgenetic alopecia diagnosis
  – Characteristic pattern of hair loss
  – Miniaturization in thinning areas
  – Family history is supportive but not necessary
Patient Evaluation

• Evaluate for miniaturization using a densitometer to observe small area of clipped scalp
Patient Evaluation

• Normal scalp
  – Thick terminal hair
  – Fine vellus hair

• Miniaturization
  – Thick terminal hair
  – Fine vellus hair
  – Intermediate diameter hair
Patient Evaluation

- Regions of the scalp
Patient Evaluation

• Norwood Classification
  – Most widely used classification of male-pattern hair loss
  – 2 types
    • Common type
    • Type A variant
Patient Evaluation

Norwood’s Classification of Male Pattern Alopecia

- I
- II
- III
- III Vertex
- IV
- V
- VI
- VII
Patient Evaluation
Patient Evaluation

Norwood’s Classification of Male Pattern Alopecia
“Type A” Variant

IIa

IVa

IIIa

Va
Patient Evaluation
Patient Evaluation

- Studies reveal negative psychosocial impact with hair loss
  - Body image dissatisfaction
  - Negative stereotype:
    - Older
    - Weaker
    - Less attractive

- Counsel patients on expectations with treatment
Medical Treatment
Medical Treatment

• Goals
  – Increase coverage of the scalp
  – Retard further hair thinning

• Drugs
  – Minoxidil: unknown mechanism for hair growth stimulation
  – Finasteride: competitive inhibitor of type 2 5-alpha reductase
  – Dutasteride: competitive inhibitor of type 1 and 2 5-alpha reductase
Medical Treatment

- Effect of Minoxidil applied topically at 2% and 5% concentrations BID (NEJM 1999- VH Price)
Medical Treatment

• Effect of Finasteride given at 1mg PO QD (NEJM 1999- VH Price)
Medical Treatment

- Effect of Dutasteride given at 0.5mg PO QD in 1 patient (J Drugs Derm 2005- M Olszewska et al)
Surgical Techniques

• Goal
  – Achieve the greatest hair density while retaining complete undetectability and natural appearance
Surgical Techniques

- Scalp Reduction
- Scalp Flaps
- Hair Transplantation
Scalp Reduction

- Originally described in 1978 by Unger and Unger
- Excise non-hair-bearing scalp in excision pattern suitable for patient
  - Sagittal midline ellipse
  - "Y" pattern
  - Lateral patterns ("S", "J", and "C")
  - "U" pattern
  - Miscellaneous patterns ("T", "I", transverse ellipse, crescent ellipse)
Scalp Reduction

• Bald scalp excised to pericranium, but not through pericranium
• Wide undermining with primary closure
Scalp Reduction
Scalp Reduction
Scalp Reduction

• Complications
  – Excessive scalp excision
    • Tension on wound closure
      – Possible tissue necrosis
      – Scar widening
  – “Stretch-Back”
    • Tendency of bald scalp to expand after each reduction
      – Between 10-50% of total reduction
      – Majority occurs within 2 months of surgery
Scalp Reduction

• Techniques Opposing “Stretch-Back”
  – Scalp Extenders
    • Silastic with hooks attached to deep galeal surface with hooks parallel to incision
  – Anchoring Galeal Flaps
    • Rectangular galea strips on one side of incision sutured to undersurface of opposing flap
  – Nordstrom Suture
    • Elastic silicone polymer suture attached to galea
Scalp Flaps

- Advancement or rotation of hair-bearing scalp
- Provides immediate coverage of alopecic areas
- Types
  - Lateral Scalp Flap
  - Temporoparietooccipital Flap (Juri Flap or Fleming-Mayer Flap)
  - Preauricular Flap
  - Free Scalp Flaps
Scalp Flaps

• Complications
  – Elevation of hairline associated with donor region
  – Possibility of flap necrosis and donor area necrosis
  – Unnatural appearance of hair growth direction
Tissue Expanders

• Increases surface area of hair-bearing scalp
• Placed between galea and pericranium
• Used in conjunction with Scalp Reduction and Scalp Flaps
Tissue Expanders

A  B  C

D  E
Follicular Unit Transplantation

- Patient Preparation
- Anesthesia
- Graft Harvesting
- Graft Dissection
- Recipient Sites
- Post-op Care
Follicular Unit Transplantation

- Technique pioneered by Dr. Bobby Limmer

- Graft Dissection Technique
  - Separate follicular units from surrounding tissue
    - Want small grafts with minimal epithelium to allow for
      - Smallest recipient site necessary
      - Limits skin trauma and preserves blood supply
  - Avoid disrupting unit structures
• Follicular graft units have between 1 and 4 hair follicles
Follicular Unit Transplantation

• Patient preparation
  – Upright position
  – Trim donor area to 1-2mm with electric clippers
    • From occipital protuberance medially to over ears laterally
Follicular Unit Transplantation

• Oral sedation may be used
• Local anesthesia
  – Mixture of 60% lidocaine 0.5% and 40% bupivacaine 0.025% with 1:200,000 epinephrine and sodium bicarbonate 8.4%, 1:20
    • Lidocaine for quick onset
    • Bupivacaine for increased duration
    • Epinephrine for hemostasis and increased duration
    • Sodium bicarbonate to decrease stinging
Follicular Unit Transplantation

• Donor area anesthesia
  – Inject into deep subcutaneous fat layer
  – Extend injection 1cm inferiorly and several cm lateral of graft margins

• Recipient area anesthesia
  – Inject into superficial dermis and subcutaneous space
Follicular Unit Transplantation

• After initial injections, tumescent anesthesia administered to midfat
  – Lidocaine 0.17% and epinephrine 1:600,000
  – Purpose
    • Increases follicular distance from nerves and blood vessels
    • Increases ridgidity of donor area
    • Decreases bleeding
    • More uniform anesthesia
    • Reduce total amount of anesthesia required
Follicular Unit Transplantation

• Graft harvesting
  – Follicular Unit Extraction
    • Involves individual unit harvesting by making using a punch
      – Good for minimal hair loss
      – Does not leave linear scar if people wear hair short
      – Only 2-3 people can work at once
  – Donor Strip Harvest
    • Currently used method
Follicular Unit Transplantation

• Donor Strip Harvest
  – 1cm wide graft is harvested from posterior middle scalp at the external occipital protuberance—“the permanent zone”
    • Want to be above muscular insertion
    • Do not want to harvest from a potential area of future hair loss
Follicular Unit Transplantation

• Donor Strip Harvest
  – Best performed with Rassman handle loaded with two 10 blades set 1.2cm apart
    • Handle holds blades angled at 30 degrees to minimize follicular transection
  – May be performed freehand with 10 blade
    • Pro: allows blade angle to be adjusted
    • Con: difficult to keep width uniform
Follicular Unit Transplantation
Follicular Unit Transplantation

- Donor strip elevated in subcutaneous plane
Follicular Unit Transplantation

- Strip ends are tapered to 1.5 strip width for closure purposes
- Preferred closure method with 5-0 absorbable suture
  - Running skin stitch
    - 1.5mm from wound edge
    - Advance approximately 5mm
  - Minimizes entrapment and destruction of follicles
Follicular Unit Transplantation
Follicular Unit Transplantation

• Staples also can be used for closure
  – Pro:
    • No tissue reactivity
  – Cons:
    • Difficult wound apposition
    • Uncomfortable for patient
    • May result in stretched scar
Follicular Unit Transplantation
Follicular Unit Transplantation

- One square cm of donor tissue yields approximately 100 follicular units
Follicular Unit Transplantation

• Graft Dissection
  – Stereomicroscope
  – Divide donor strip into thin sections—“slivering”
    • Avoid follicle transection
    • Avoid dividing follicular units
Follicular Unit Transplantation
Follicular Unit Transplantation
Follicular Unit Transplantation

• Slivers are then dissected into individual follicular units
Follicular Unit Transplantation
Follicular Unit Transplantation

- Follicular units are sorted based on hair number into petri dishes of Ringer’s lactate or saline on ice
Follicular Unit Transplantation

- **Recipient Sites**
  - Do not use instrument that will remove tissue
  - Keep recipient sites small, but large enough so that grafts do not need to be forced in place
  - Visible scars are not produced by needles 18 gauge or less
Follicular Unit Transplantation

- **Recipient Sites**
  - Instrument size guide equivalents
    - 20 gauge = 1-hair unit
    - 19 gauge = 2-hair and thin 3-hair units
    - 18 gauge = 3-hair and 4-hair units
Follicular Unit Transplantation

• Recipient Sites
  – Techniques
    • Stick and Plant
      – Grafts are placed immediately after creation of recipient site
    • “Premaking” recipient sites
      – All recipient sites created prior to grafting
Follicular Unit Transplantation

• Stick and Plant Technique
  – Pros
    • Needle can be used to facilitate graft placement
    • Sites do not go unfilled
    • Avoids placing 2 grafts in one site
  – Cons
    • Increased risk of dislodging ("popping") adjacent graft when creating site
    • Must focus on design elements (angling and distribution) while performing technical aspect
Follicular Unit Transplantation

• “Premaking” Recipient Sites
  - Pros
    • Physician concentrates on design without distraction of graft handling or risk of popping
    • Allows time for coagulation improving visibility and placement
  - Cons
    • Must estimate graft number
    • Unfilled recipient sites
    • 2 grafts in one site (“piggybacking”)
Follicular Unit Transplantation

• Hair direction
  – Grafts placed at original growing angle, not direction of hair grooming
  – Hair anterior to vertex transition point should point forward
  – Angle becomes more acute as it reaches the anterior hairline
Follicular Unit Transplantation
Follicular Unit Transplantation

• Recipient Site Density
  – Average non-balding scalp has 100 follicular units per square cm
  – 50% of hair may be lost before noticeable thinning
    • Wasteful for more than 50% to be replaced
  – Up to 25 follicular units per square cm into frontal area of balding scalp is recommended
Follicular Unit Transplantation

• Recipient Site Distribution
  – Creating greatest density in front part of scalp produces best cosmetic result ("Forward Weighting")
    • Recipient sites placed closer together
    • Larger follicular units placed (3-4 hairs)
  – Recipient site density should be gradually tapered toward the crown
Follicular Unit Transplantation

• “Forward Weighting”
Follicular Unit Transplantation
Follicular Unit Transplantation
Follicular Unit Transplantation

Epidermis of graft should be slightly superficial to scalp epidermis.

Grafts placed too deep will cause cysts and ingrown hairs.

CORRECT DEPTH

INCORRECT DEPTH
Follicular Unit Transplantation
Follicular Unit Transplantation

- Operative time typically 3 to 6 hours
Follicular Unit Transplantation

• Postoperative Care
  – Wash scalp with sterile water
    • Avoid using peroxide
  – Apply antibiotic ointment and pressure headband dressing to donor site
  – Cover transplanted area with surgeon’s cap
Follicular Unit Transplantation

• Postoperative Care
  – Patient to have hair washed on post-op day 1 to remove crusts
    • Some surgeon’s have patient return to clinic for this, some permit patient to wash hair
  – Return to clinic in 1 week
  – No strenuous activity for one week
  – Pain medication
  – Photoprotection for 3 months
Follicular Unit Transplantation
Follicular Unit Transplantation
Follicular Unit Transplantation

A

B
Follicular Unit Transplantation

- Problems and Complications
  - Poor patient selection
    - Operating on young patients is difficult
      - Hairline creation looks unnatural long term
      - Do not know donor site stability
  - Poor aesthetic judgment
    - Grafts in wrong direction
    - Crown transplant in young patient who is just starting to lose hair
  - Improper graft handling
  - Wide donor scars
Follicular Unit Transplantation

• More than one procedure is often necessary
• Wait at least 6 to 8 months between procedures
Conclusions

- Evaluate and counsel patient
- Consider medical management
- Follicular Unit Transplantation is surgical technique of choice today
Baldness Portrays Being Older and Wiser
Bald is Beautiful
Or Is It?
Bibliography

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Quiz
Question 1

• Hair development begins at what gestational age?
  – A. 1 - 4 weeks
  – B. 5 – 8 weeks
  – C. 9 – 12 weeks
  – D. 13 – 16 weeks
Question 2

• List the components of a follicular unit
Question 3

- Which drugs are approved by the FDA to treat hair loss
  - A. dutasteride
  - B. minoxidil
  - C. viagra
  - D. finasteride
  - E. colace
Question 4

- What is the name of one of the main classification schemes for male pattern alopecia?
Question 5

• True or false: Micrografts are 1 – 2 hairs and minigrafts are 3 – 4 hairs.
Question 6

• True or false: Follicular unit transplantation must be done under general anesthesia.
Question 7

• How many follicular units are expected from 1 square cm of donor tissue?
Question 8

• True or false: Grafts can be placed immediately after making the recipient site ("stick and plant").
Question 9

• True or false: Follicular units should be placed in the direction that hair grooming will take place.
Question 10

• True or false:
  Only one procedure is necessary with follicular unit transplantation.