Dermatologic Surgery

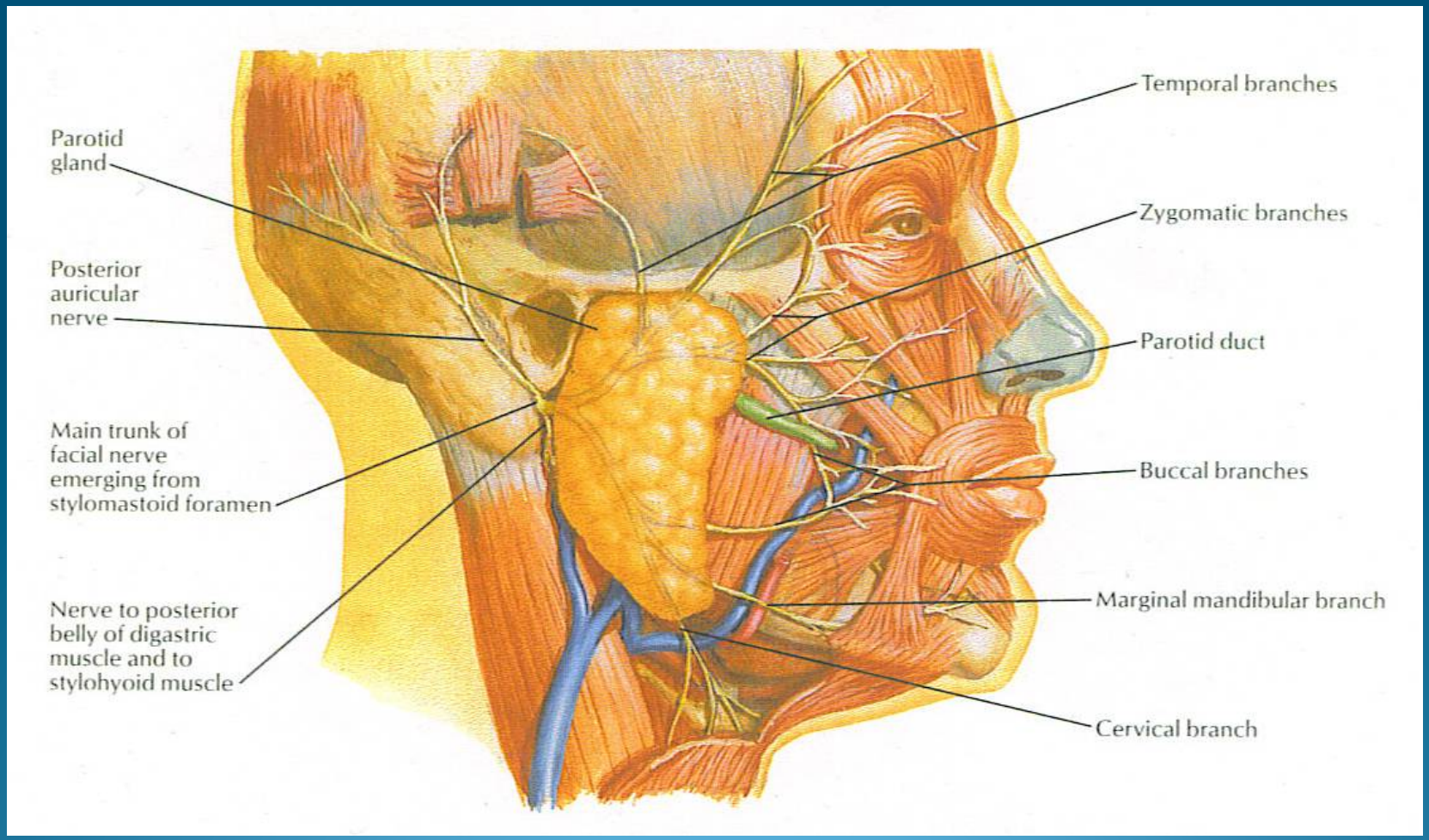
Anatomy Pearls

Motor Nerves

- Temporal branch of facial nerve; innervates frontalis and orbicularis muscles; damage causes EYEBROW PTOSIS
- Marginal mandibular branch of facial nerve; innervates orbicularis oris and lip depressors; damage causes LIP WEAKNESS and DRIBBLING WITH EATING/DRINKING
- Zygomatic and buccal branches overlap territories; damaging zygomatic causes WEAK EYE CLOSURE & ECTROPION; damaging buccal (lip elevators) causes ORAL DRIBBLING
- Cervical branch runs deep, little harm if damaged
- Accessory nerve (CN XI); located in posterior triangle of neck behind SCM at Erb's point; innervates trapezius muscle; damage causes SHOULDER DROOP & WINGED SCAPULA

Anatomy Pearls

Motor Nerves



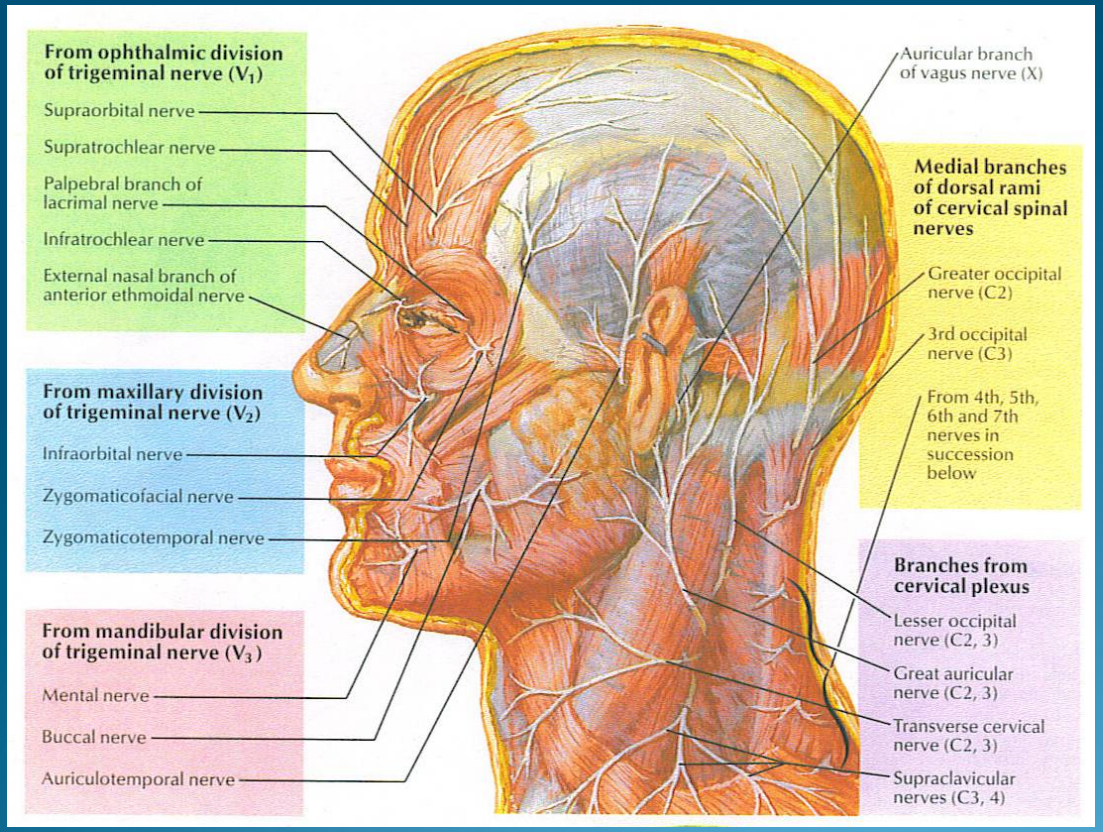
Anatomy Pearls

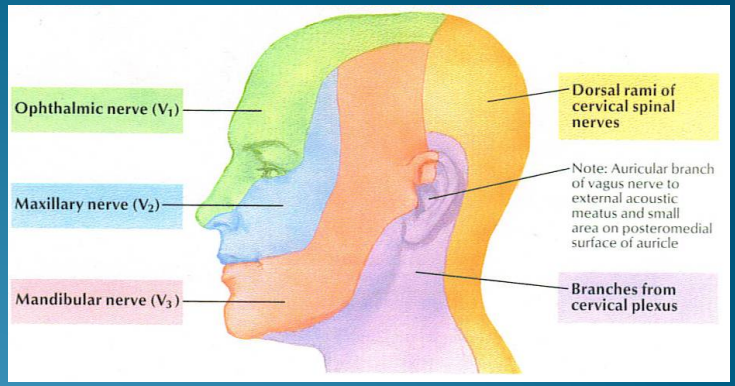
Sensory Nerves

- Division of branches of the supratrochlear and supraorbital nerves (V_1) causes FOREHEAD NUMBNESS
- Three sensory nerves emerge from posterior triangle: transverse cervical (C2,3), division numbs ANTERIOR NECK; great auricular (C2,3), division numbs EAR; lesser occipital (C2,3), division numbs POST-AURICULAR AREA

Anatomy Pearls

Sensory Nerves

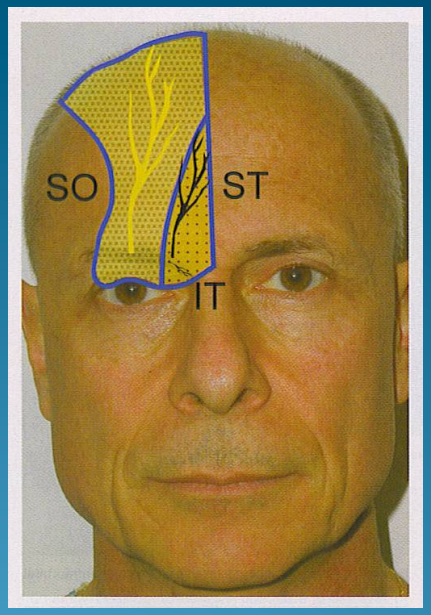


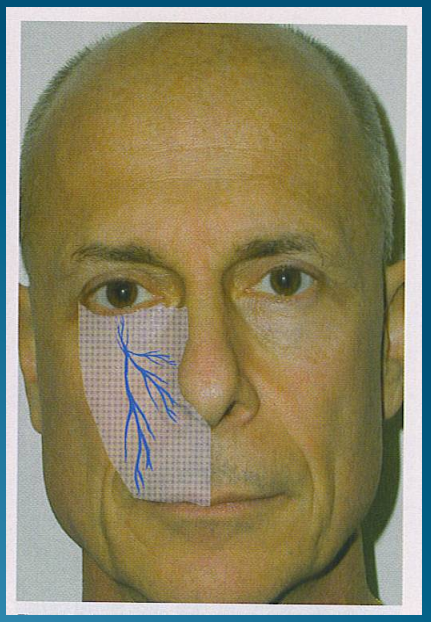


Anatomy Pearls

Sensory Nerve Blocks

Nerve	Territory
Supraorbital (V_1)	Forehead
Supratrochlear (V_1)	Medial forehead
Infratrochlear (V_1)	Medial upper eyelid, nasal root
Infraorbital (V_2)	Lower eyelid, cheek, nasal sidewall, upper lip
Mental (V_3)	Lower lip, chin





Anatomy Pearls

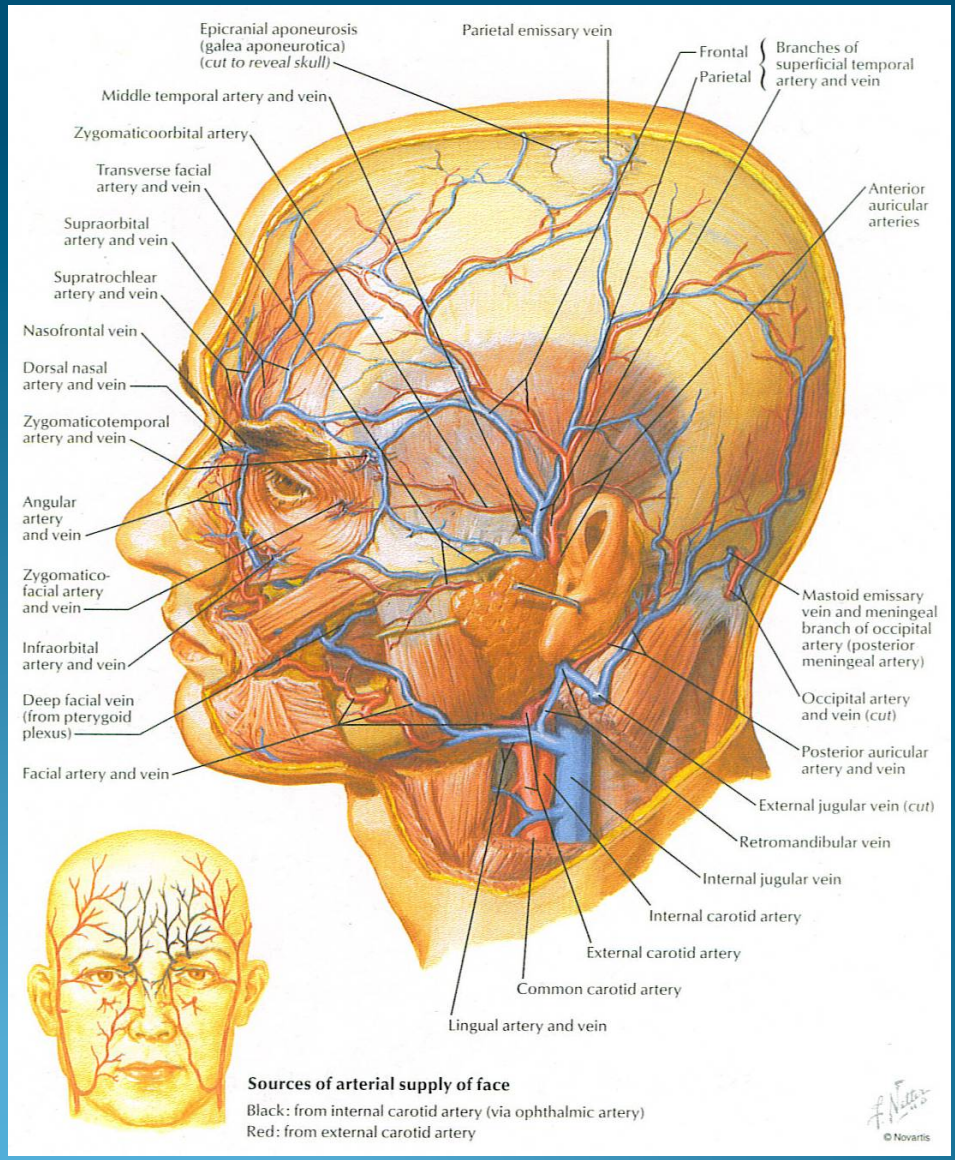
Arteries and Veins

Arterial Supply:

- Internal carotid (ophthalmic)
- External carotid

Vulnerable Vessels:

- Superficial temporal artery
- Angular artery (nasolabial)
- Parietal emissary vein (subgaleal space)
- External jugular vein
- Parotid duct (over masseter)



Anatomy Pearls

Musculature

SMAS (Superficial musculoaponeurotic system):

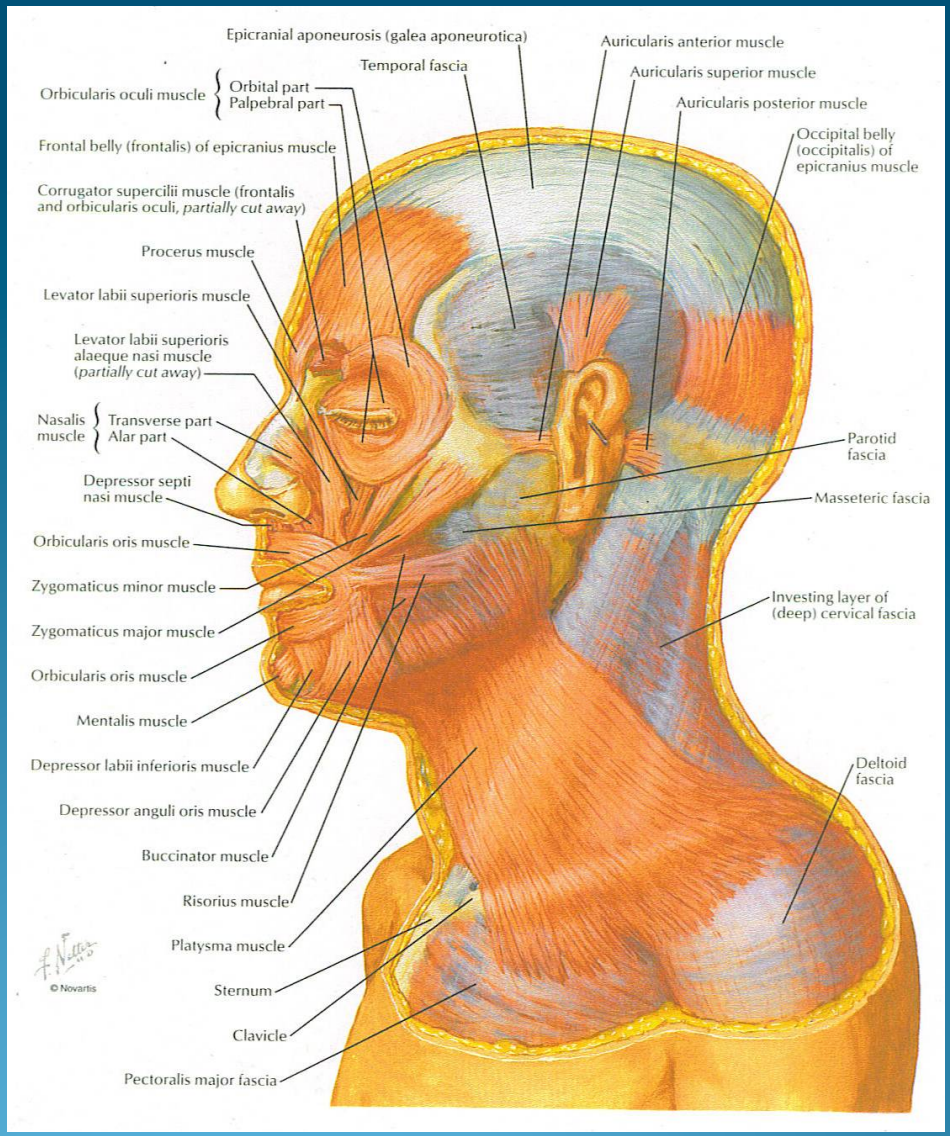
- Fibrous sheath on head & neck between dermis and muscular fascia
- Continues on scalp as galea aponeurotica
- Most major vessels within or beneath SMAS

SCALP Layers:

- S = Skin
- C = Connective tissue
- A = Aponeurosis (galea)
- L = Loose areolar connective tissue
- P = Pericranium (periosteum)

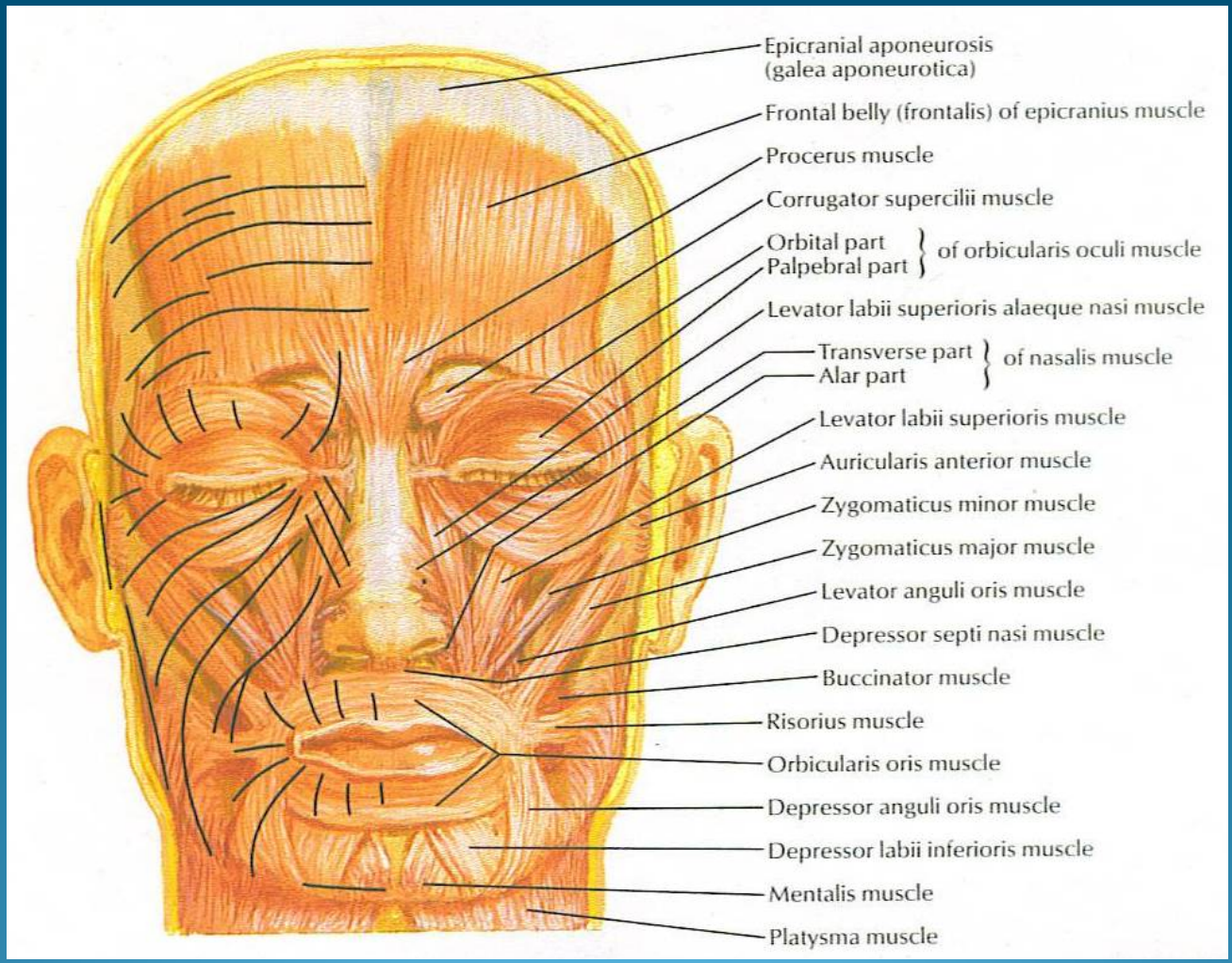
Anatomy Pearls

Musculature

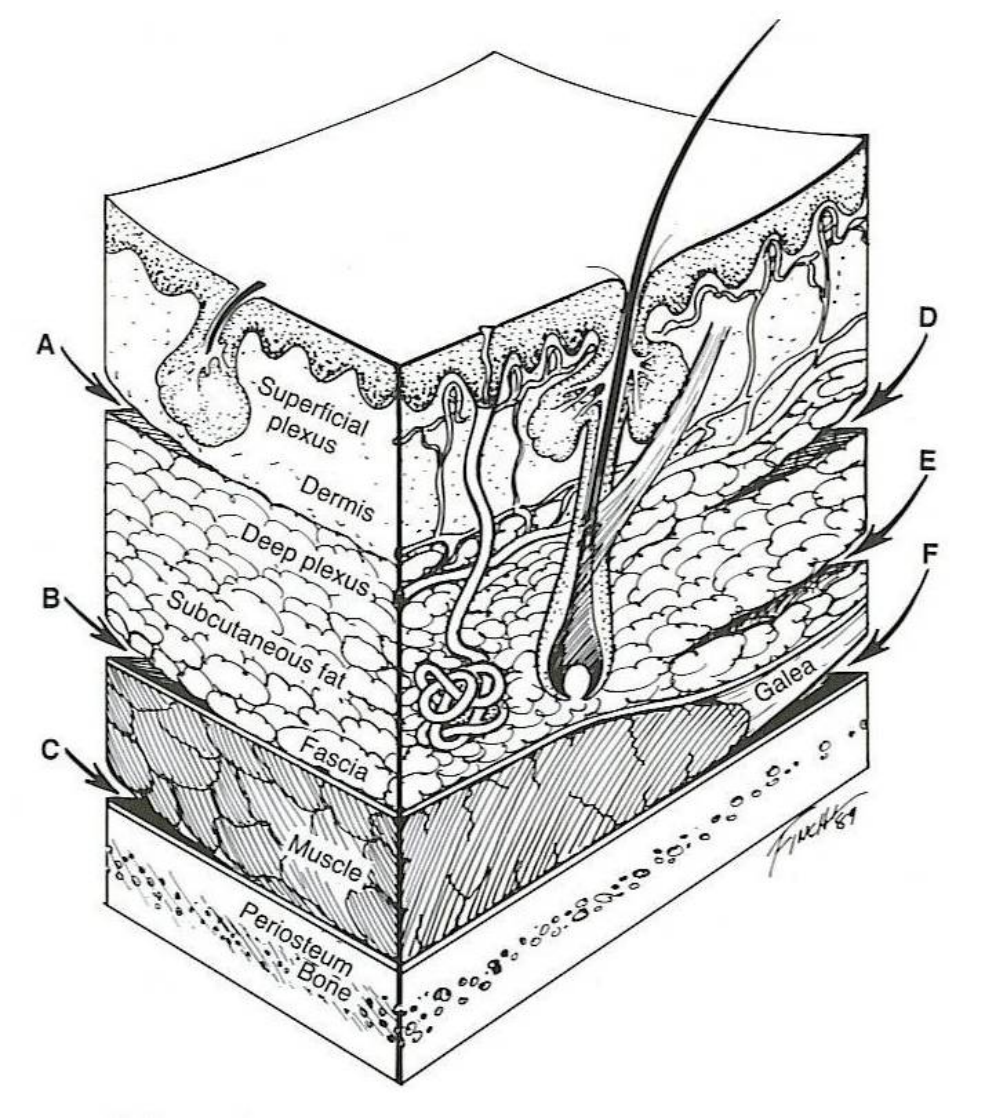


Anatomy Pearls

Musculature



Undermining Levels



A: Nose, sebaceous portion (subdermal)

B: Forehead, eyelids, lips, limbs, dorsum of nose (fat/ fascia)

C: Forehead vertical wounds (submuscular)

D: Cheek (high subcutis)

E: Beard, sideburns (subfollicular)

F: Scalp (subgaleal)

Local Anesthetics

- Block Na^+ influx into neurons, preventing depolarization
- Preferentially block unmyelinated C-fibers (pain, temp) compared to myelinated A-fibers (pressure, motor)
- All local anesthetics vasodilating except cocaine which vasoconstricts
- Classified into amides and esters
- Amides (e.g. lidocaine) metabolized by liver
- Esters (e.g. procaine) metabolized by plasma pseudocholinesterase. Patients deficient in this enzyme have increased toxcity to esters. Esters cross react w/ PABA.
- Multidose vials contain parabens preservative => allergic rxn
- Pearl: Bupivicaine (Marcaine) longest acting (3-10 hrs)

Local Anesthetics

Local Anesthetics

Generic Name	Trade Name	Primary Use	Relative Potency	Onset	Duration* Plain	Maximum† Dose Plain	Maximum† Dose with Epinephrine
Amides							
Bupivacaine	Marcaine	Infiltration	8	2–10 min	3–10 h	175 mg	250 mg
Dibucaine	Nupercaine	Topical		Rapid	Short		
Etidocaine	Duranest	Infiltration	6	3–5 min	3–10 h	300 mg	400 mg
Lidocaine	Xylocaine	Infiltration/Topical	2	Rapid	1–2 h	300 mg	500 mg (3850 mg dilute)
Mepivacaine	Carbocaine	Infiltration	2	3–20 min	2–3 h	300 mg	400 mg
Prilocaine	Citanest	Infiltration	2	Rapid	2–4 h	400 mg	600 mg
Prilocaine/Lidocaine	EMLA	Topical		30–120 min	Short		
Esters							
Benzocaine	Anbesol, etc.	Topical		Rapid	Short		
Chloroprocaine	Nesacaine	Infiltration	1	Rapid	0.5–2 h	600 mg	
Cocaine		Topical		2–10 min	1–3 h	200 mg	
Procaine	Novocaine	Infiltration	1	Slow	1–1.5 h	500 mg	600 mg
Proparacaine	Ophthaine	Topical		Rapid	Short		
Tetracaine	Pontocaine	Infiltration	8	Slow	2–3 h	20 mg	
Tetracaine	Cetacaine	Topical		Rapid	Short		

*In clinical practice the duration of anesthesia appears to be less than stated above, especially for head and neck areas, and addition of epinephrine prolongs anesthesia by a factor of two.
†Maximum doses are for a 70-kg person.

Local Anesthetics

Lidocaine

- Lidocaine 1% with 1:10,000 epi is standard
- Lidocaine 1% = 1 g / 100 mL or 10 mg / mL
- Max doses: 5 mg/kg of 1% lido; 7 mg/kg of 1% lido with epi; 55 mg/kg for tumescent anesthesia (0.05-0.1% lido with 1:100,000 epi). Max dose for 70 kg patient using standard lido with epi = 490 mg = 49 mL
- Lidocaine toxicity:
  - Low blood levels: anxiety, tinnitus, tingling, numbness, nausea, vomiting, metallic taste, diplopia
  - Moderate: nystagmus, tremor
  - High: Convulsions, respiratory arrest

Local Anesthetics

Epinephrine

- Use: added to anesthetic for vasoconstrictive properties (bloodless field, longer duration of analgesia)
- Absolute contraindications: hyperthyroid, pheochromocytoma
- Relative contraindications: HTN, severe CAD, narrow angle glaucoma, pregnancy, β-blockers, MAO inhibitors, TCAs
- Epinephrine toxicity:
  - Low: palpitations, anxiety, diaphoresis, HA, tremor, weakness
  - High: Cardiac arrhythmias, cerebral hemorrhage
- Avoid injection into digits or penis

Local Anesthetics

Topical anesthetics

- Good for children and lasers
- EMLA = Eutectic Mixture of Local Anesthetics = lidocaine + prilocaine; thick smear necessary
- Tetracaine (amethocaine) gel; thin smear OK, may cause urticaria
- LMX = Lidocaine 4%

Suture Materials

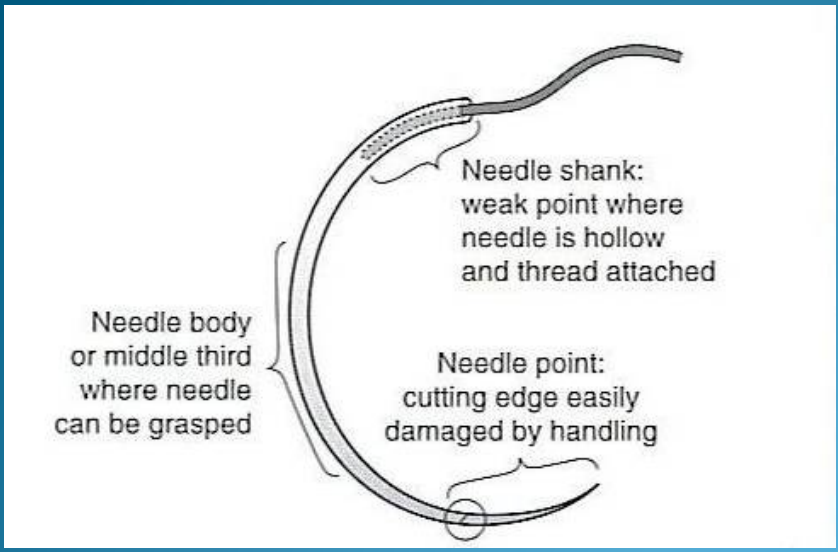
- Monofilament vs braided
- Absorbable vs non-absorbable
- Suture properties:
  - Memory: tendency to retain original shape
    Braided = low memory = better knot security
  - Tissue reactivity
    Monofilament & synthetic = lower reactivity
  - Tensile strength. Synthetic & nonabsorbable = strong
- Silk used for mucosal surfaces
- Maxon & PDS are absorbable sutures with high tensile strength

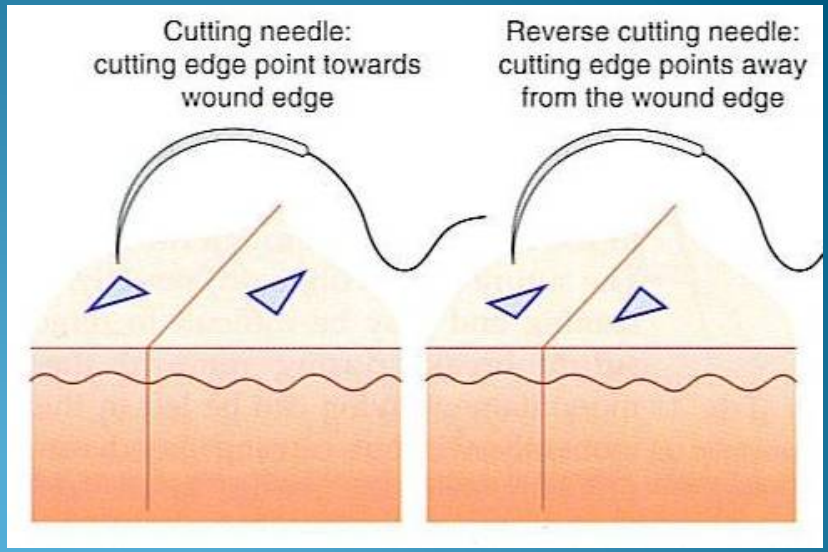
Suture Materials

	Type	Memory	Tissue Reactivity	Tensile Strength Half-Life
Nonabsorbable				
Cotton	Twisted	Low	Very high	—
Nylon (Ethilon, Dermalon)	Monofilament	High	Low	—
Nylon (Nurolon, Surgilon)	Braided	Low	Low	—
Polybutester (Novafil)	Monofilament	High	Low	—
Polyester, uncoated (Mersilene)	Braided	Low	Low	—
Polyster, coated (Ethibond)	Braided	Low	Low	—
Polypropylene (Prolene, Surgilene)	Monofilament	Very high	Very low	—
Silk	Braided/twisted	Very low	High	—
Stainless steel	Monofilament/ braided/twisted	Very high	Very low	—
Absorbable				
Catgut, fast absorbing/mild chromic	Twisted	Very high	High	2 days
Catgut	Twisted	Very high	High	4 days
Catgut, chromic	Twisted	Very high	High	1 week
Polyglactin 910 (Vicryl)	Braided	Very low	Low	2 weeks
Polyglycolic acid (Dexon)	Braided	Very low	Low	2 weeks
Poliglecaprone 25 (Monocryl)	Monofilament	Low	Very low	1 week
Polyglyconate (Maxon)	Monofilament	Low	Very low	1 month
Polydoxanone (PDS)	Monofilament	High	Very low	1 month

Suture Needles

- Anatomy: Shank, body, point
- Cutting: cutting edge on inner curvature of needle facing towards wound edge
- Reverse cutting (preferred in skin surgery): cutting edge on outer curvature of needle facing away from wound edge, thus less risk of tearing through skin





Suture Closure Pearls

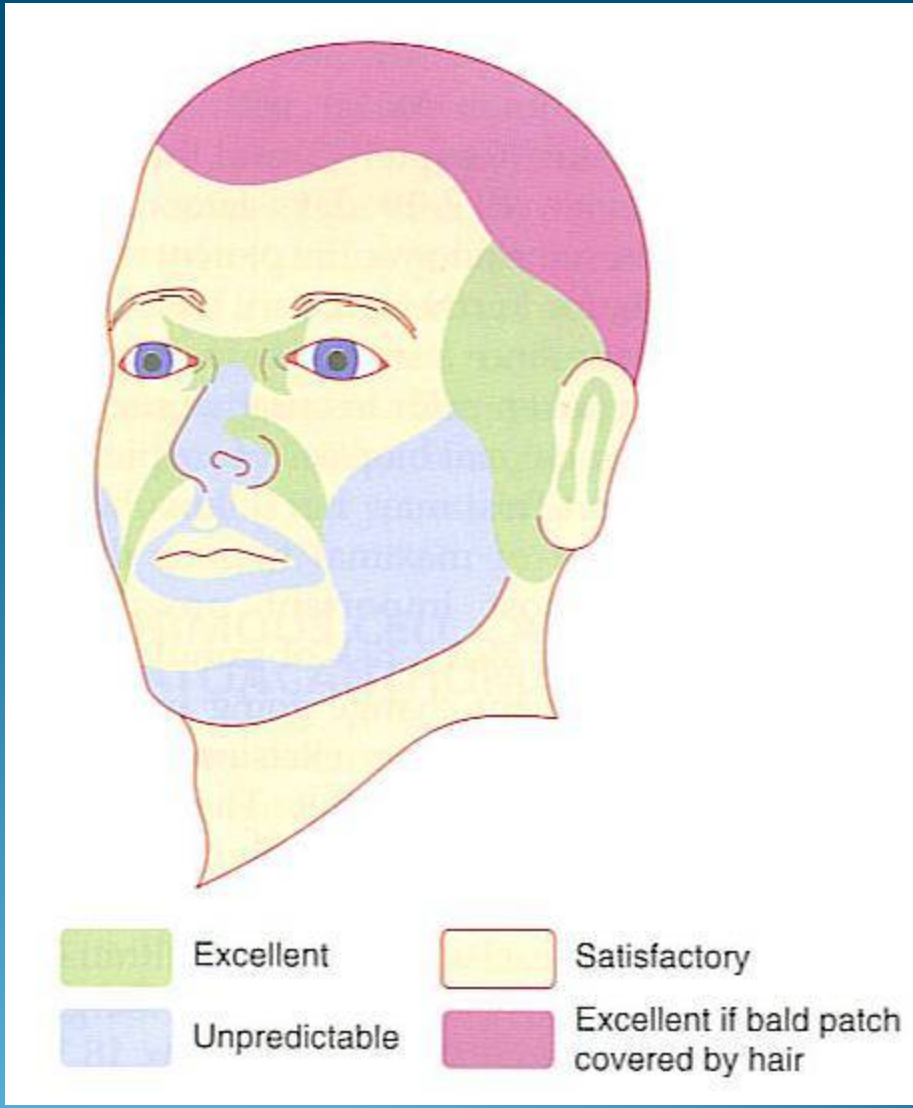
Suture Technique	Used For
Vertical mattress	Wound eversion, high tension
Running subcuticular	No suture track marks
Running simple	Low tension closure
Figure of eight	Bleeding vessel
Tip stitch (Half buried horizontal mattress)	Avoid flap tip necrosis
Pulley stitch	High tension wounds

Second Intention Healing

Good Areas

- Medial canthus
- Nasolabial fold
- Scalp
- Ear concha
- Pre- and post-auricular skin

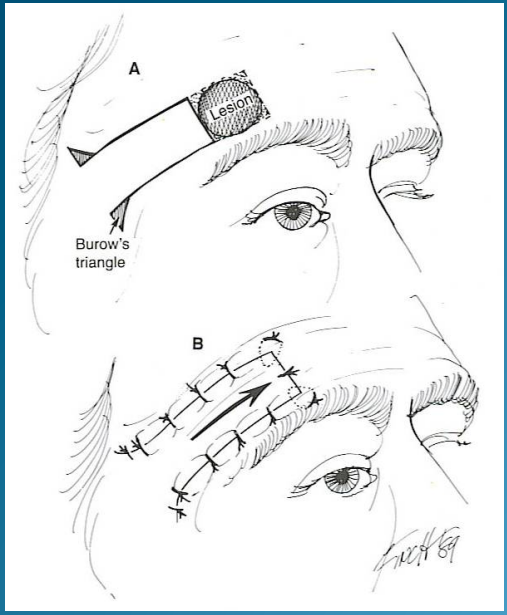
(Avoid free margin)



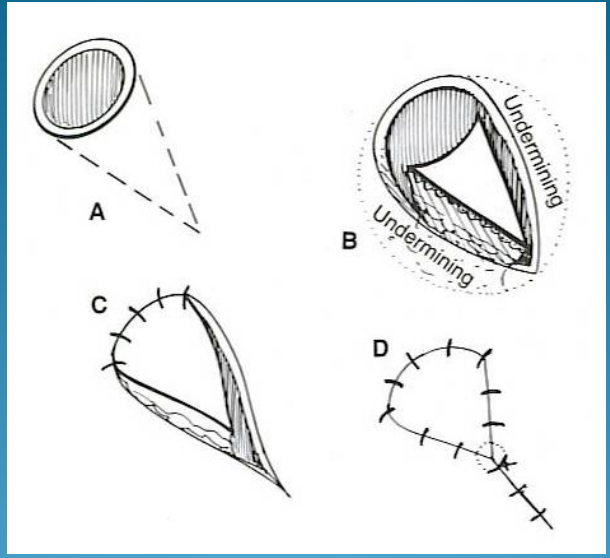
Flaps

Advancement

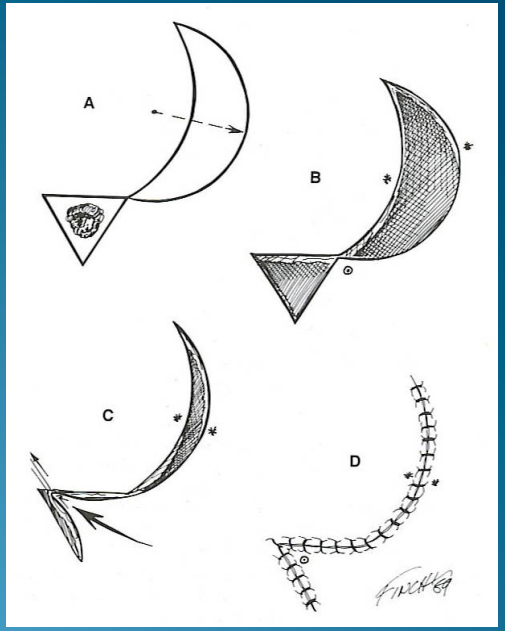
- Movement in straight line; keep length to width ≤ 3:1
- Types: Single pedicle, double pedicle, island pedicle, perialar crescentic



Single Pedicle



Island Pedicle

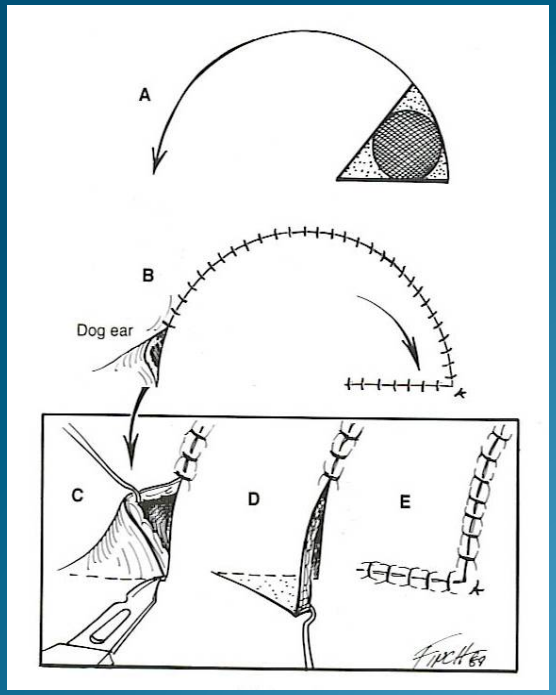


Perialar crescentic

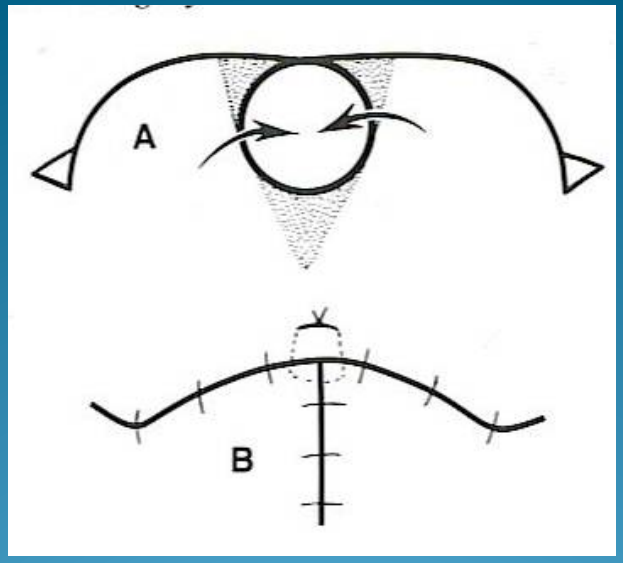
Flaps

Rotation

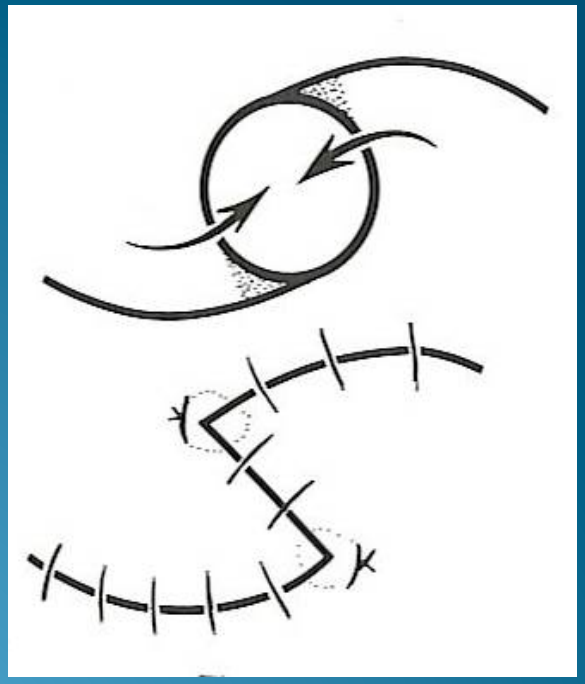
- Types: Simple, O-T, O-Z



Simple



O-T

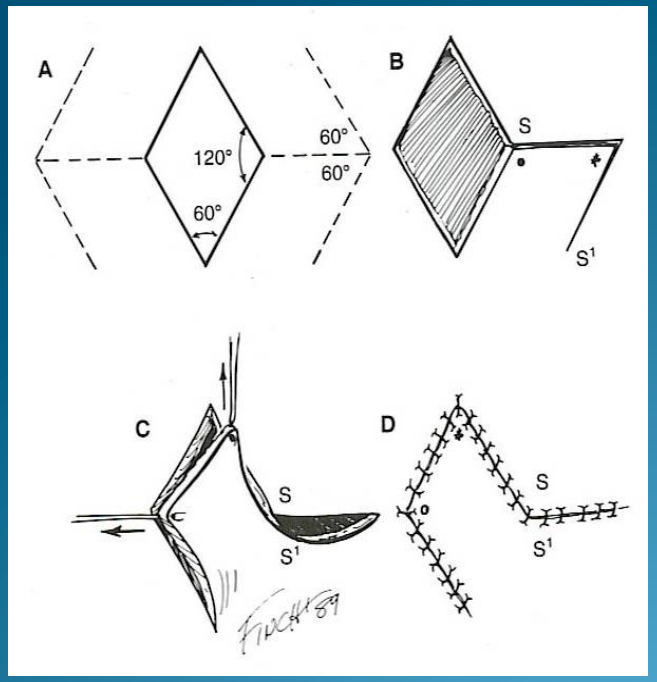


O-Z

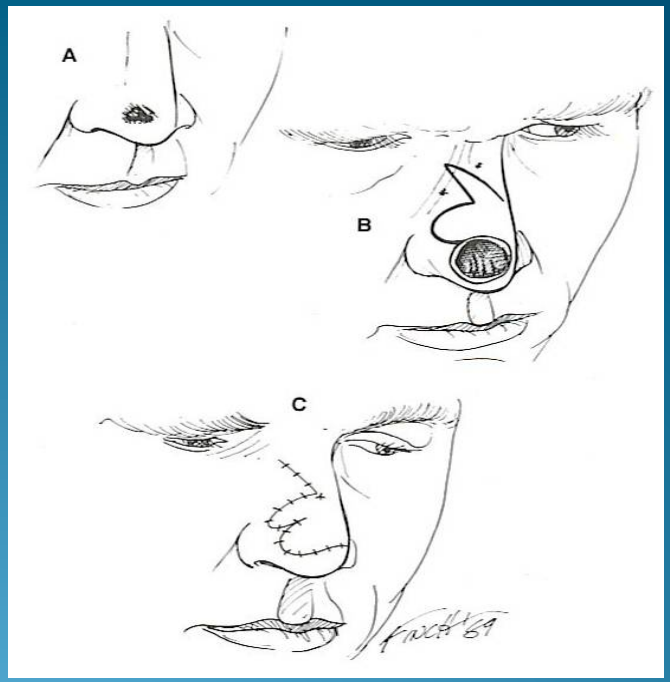
Flaps

Transposition

- Types: Rhombic, banner, bilobed, Z-plasty, nasolabial



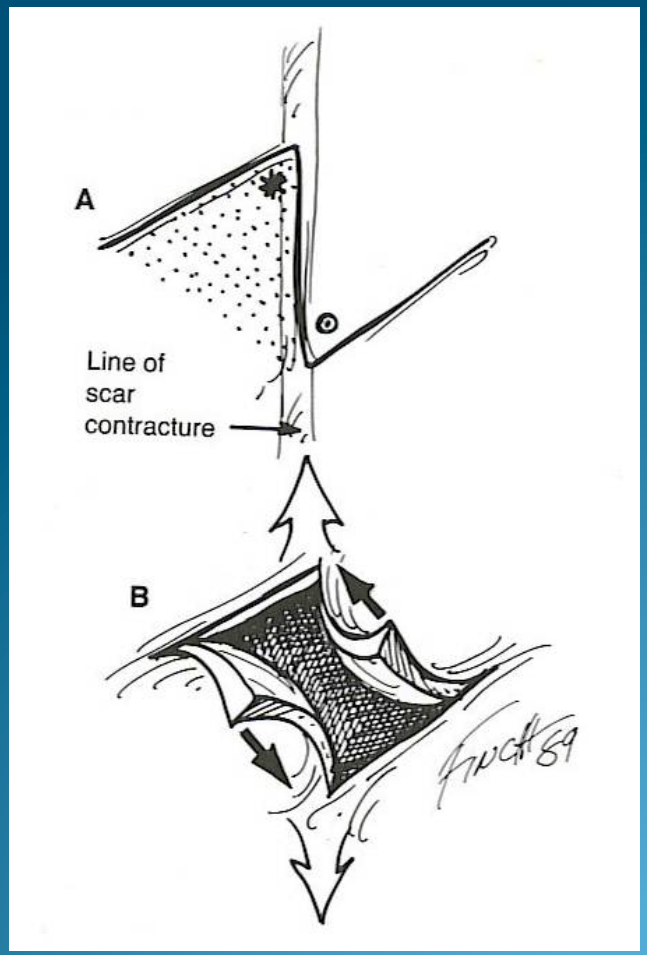
Rhombic



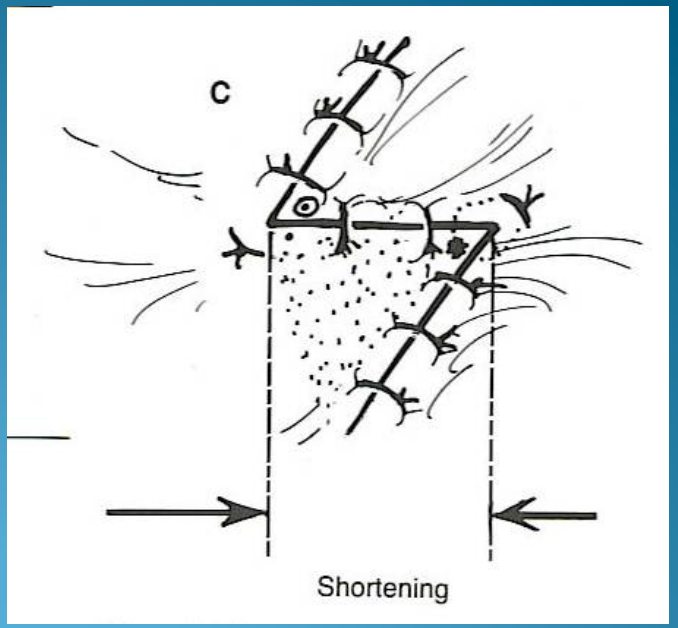
Bilobed

Flaps

Transposition



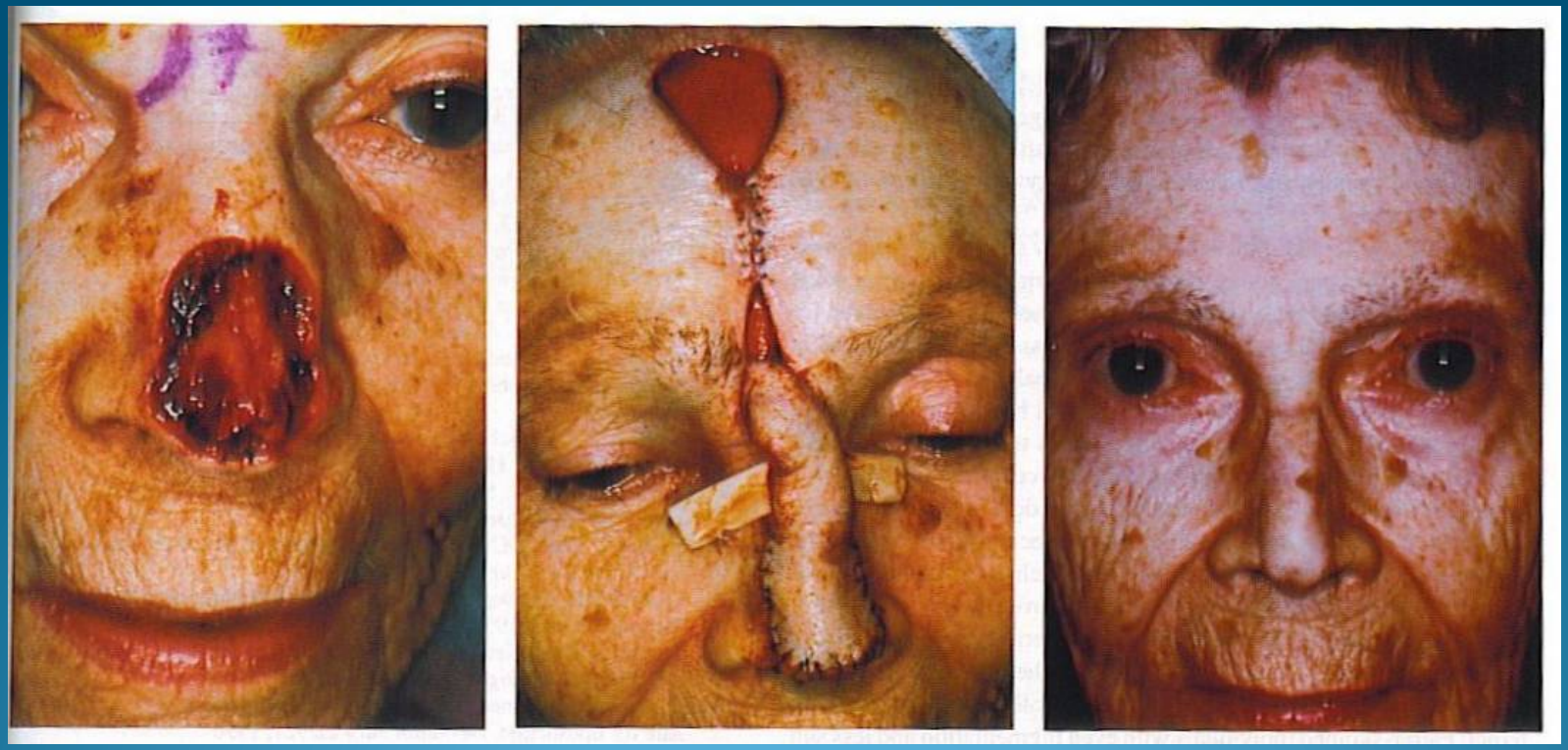
Z-plasty: breaks up scar lines



Flaps

Other: Paramedian Forehead Flap

- Two stage transposition flap used for large nasal tip defects
- Vascular supply of pedicle supplied by supratrochlear artery



Grafts

- Types of Grafts:
  - Split thickness: Epidermis + variable dermis. Good for large defects, no repair needed at donor site.
  - Full thickness: Entire epidermis and dermis. Better cosmesis than STSG, but donor site requires repair.
  - Composite: Skin + cartilage, higher failure rate.
- Factors that affect survival:
  - Graft vascularity
  - Wound bed vascularity
  - Graft thickness (thinner does better)
  - Contact between graft and bed (drain hematoma)

Electrosurgery

- Unipolar (device tip to electrode on limb), Bipolar (between forceps tips), Monoterminal (current dissipates in tissue, risk of burns to operator)
- Electrodessication and electrofulguration: superficial destruction, *highly dampened* sine waveform current; dessication direct contact with tissue, fulguration arc across gap (*fulgur* = lightning)
- Electrocoagulation and electrocautery: deeper penetration, *moderately dampened* waveform; in electrocoagulation, resistance occurs at tissue, so electrode tip at ambient temperature; in electrocautery, resistance at tip which becomes hot and then coagulates by heat transfer
- Electrosection: cutting tissue, *undampened* sine waveform

Cryosurgery

Freon	-32 to +3.6ºC
CO_2	-78.5 ºC
NO	-89.5 ºC
LN2	-196.5 ºC

- Must reach –50 ºC to destroy cancer cells; -25 ºC to destroy benign cells

Melanoma Staging

Table 1. Staging Criteria for Melanoma.*

Pathological and TNM Stage	Thickness of Lesion	Ulceration	No. of Involved Lymph Nodes	Nodal Involvement	Distant Metastasis
	mm				
IA	≤1.0	No	0	—	No
IB					
T1b	≤1.0	Yes or Clark level IV or V	0	—	No
T2a	1.01–2.0	No	0	—	No
IIA					
T2b	1.01–2.0	Yes	0	—	No
T3a	2.01–4.0	No	0	—	No
IIB					
T3b	2.01–4.0	Yes	0	—	No
T4a	>4.0	No	0	—	No
IIC	>4.0	Yes	0	—	No
IIIA					
N1a	Any	No	1	Microscopic	No
N2a	Any	No	2 or 3	Microscopic	No
IIIB					
N1a	Any	Yes	1	Microscopic	No
N2a	Any	Yes	2 or 3	Microscopic	No
N1b	Any	No	1	Macroscopic	No
N2b	Any	No	2 or 3	Macroscopic	No
IIIC					
N1b	Any	Yes	1	Macroscopic	No
N2b	Any	Yes	2 or 3	Macroscopic	No
N3	Any	Yes or no	4	Macroscopic or microscopic	No
IV					
M1a	Any	Yes or no	Any	Any	Skin, subcutaneous
M1b	Any	Yes or no	Any	Any	Lung
M1c	Any	Yes or no	Any	Any	Other visceral site

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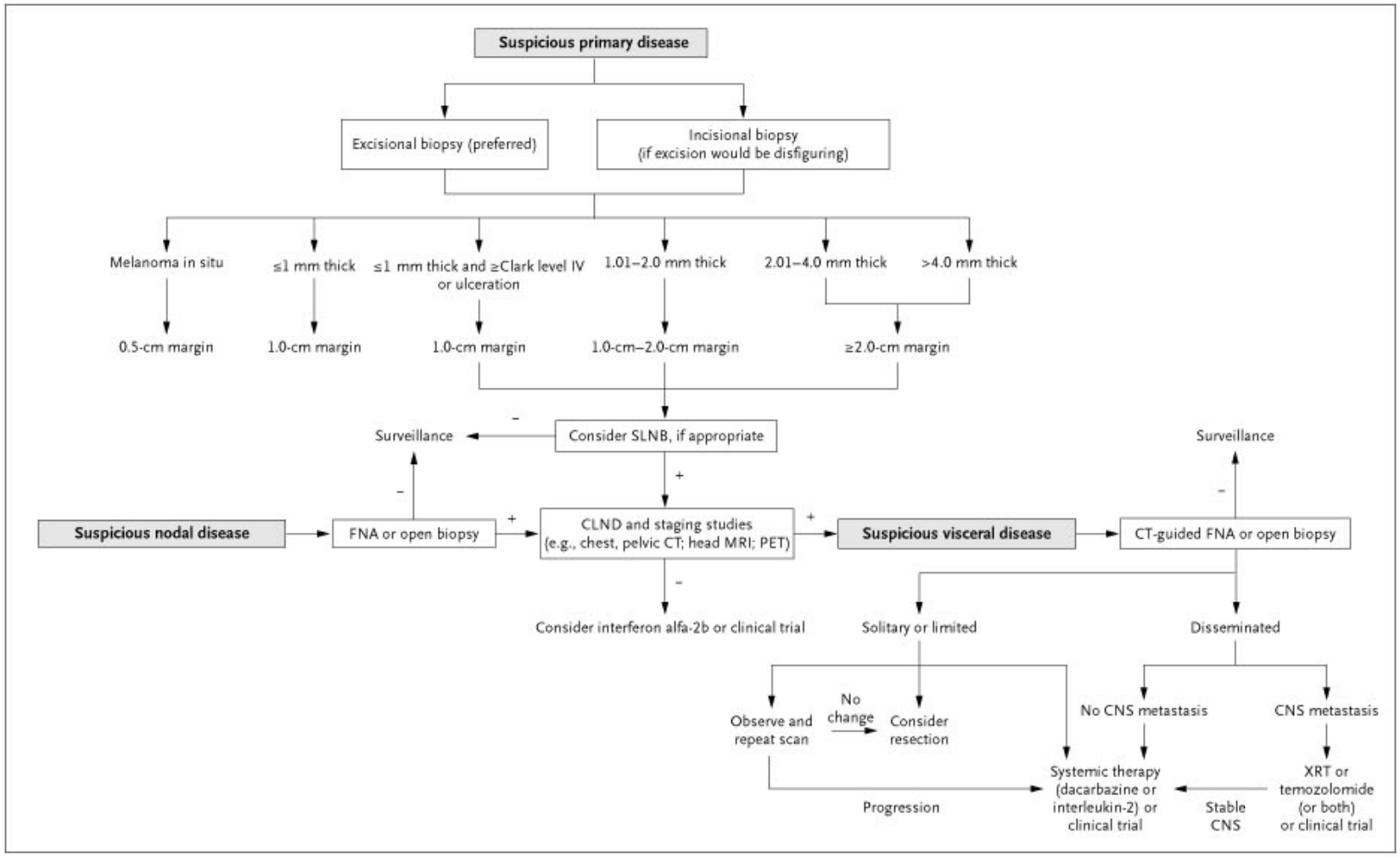
Melanoma Treatment



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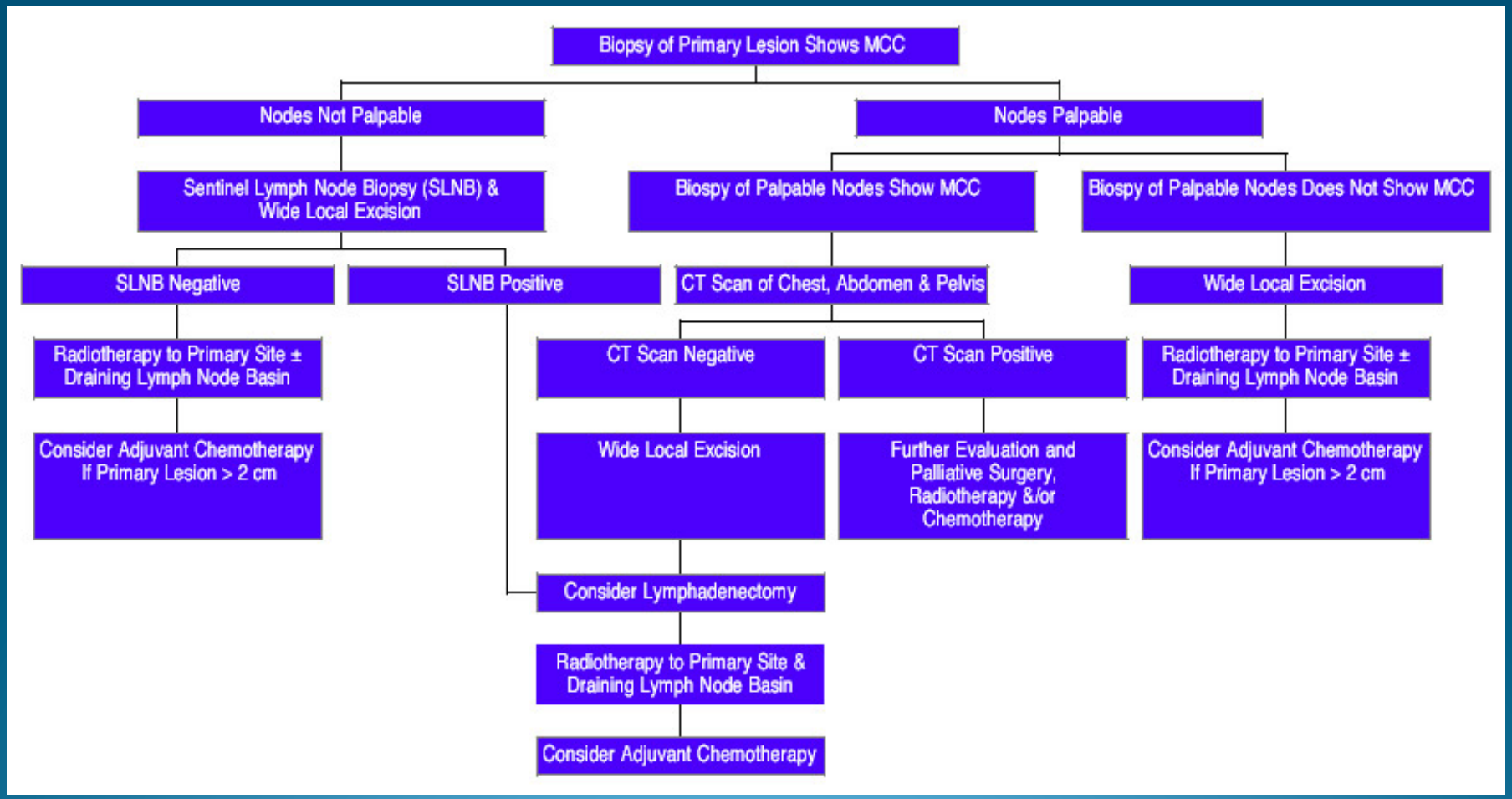
Merkel Cell Staging

Stage		Localized Disease	Lymph Node	Metastasis
IA	Primary lesion <= 2 cm	+	-	-
IB	Primary lesion > 2 cm	+	-	-
II	Positive lymph node	+/-	+	-
III	Distant metastasis	+/-	+/-	+

www.merkelcell.org

Merkel Cell Treatment



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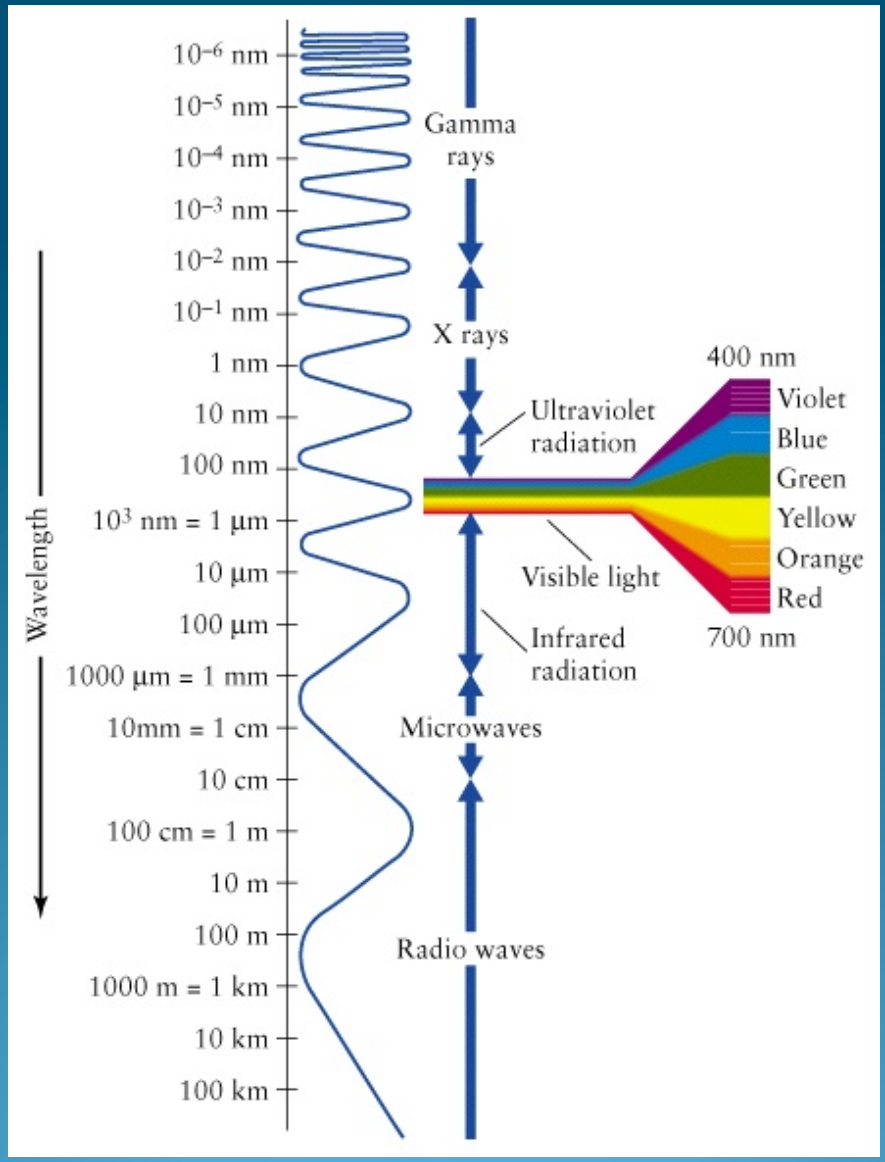
Electromagnetic Spectrum



Important Wavelengths

Spectrum	Wavelength (nm)
Ultraviolet	1-400
UVC	200-280
UVB	280-320
nb-UVB	310-312
UVA2	320-340
UVA1	340-400
Visible	400-700
Infrared	700-10,000

Theory of Lasers

- How it works: Energy source excites atoms of lasing medium, atoms decay from metastable state back to ground state, emitting coherent photons
- Terminology: energy (joules), power (watts), fluence (joule/cm^2), irradiance (watts/cm^2)
- Longer wavelengths penetrate deeper in skin
- Laser modes: continuous, pulsed, Q-switched
- Selective photothermolysis: pulse duration < thermal relaxation time
- Chromophores: melanin, oxyhemoglobin, water

Lasers in Dermatology

Laser	λ (nm)	Target / Use	Tattoo	Risks	Spectrum
Excimer	193, 308, 355	Psoriasis, vitiligo, LASIK		Cataract formation	UV
Argon	488, 514	Vascular, photodynamic			Visible
Pulsed Dye Green	510	Melanin	Red		Visible
Copper Vapor / Bromide	512, 578	Vascular, melanin			Visible
Krypton	520, 568	520 (melanin); 568 (vascular)			Visible
KTP	532	Vascular, melanin		Retinal injury (low)	Visible
Freq doub Nd:YAG, LP	532	Telangectasias, melanin		Retinal injury (high)	Visible
Freq doub Nd:YAG, QS	532	Melanin	Red	Retinal injury (high)	Visible
Pulsed Dye Yellow	577-600	Vascular (PWS), warts, keloids		Retinal injury (low)	Visible
Ruby, LP	694	Hair removal		Retinal injury (high)	Visible
Ruby, QS	694	Lentigines, Nevus Ota	Black, blue, green	Retinal injury (high)	Visible
Alexandrite, LP	755	Hair removal, leg veins		Retinal injury (high)	Infrared
Alexandrite, QS	755	Lentigines, Nevus Ota	Black, blue, green	Retinal injury (high)	Infrared
Diode	800-1000	Hair removal, vascular lesions		Retinal injury (high)	Infrared
Nd:YAG, LP	1064	Hair removal, vascular lesions		Retinal injury (high)	Infrared
Nd:YAG, QS	1064	Lentigines, Nevus Ota	Black	Retinal injury (high)	Infrared
Erb:YAG	2940	Ablate warts, keratoses, skin resurface		Corneal injury, burns	Infrared
Carbon Dioxide	10,600	Ablate warts, keratoses, skin resurface		Corneal injury, burns	Infrared
Xenon Flashlamp (IPL)	500-1200	Vascular and pigmented		Retinal injury (low)	Visible/IR

Laser Pearls

- PDL 585 for removal of Port Wine Stains
- CO_2 laser for actinic cheilitis
- Scarring from continuous wavelength lasers = Argon, Krypton, Carbon Dioxide
- Excimer laser only UV spectrum laser; causes cataracts
- Corneal injury and burns from Erb:YAG and CO_2
- Q-switched lasers best for tattoo removal (short pulse duration good for small compartment size)
- Mechanism of laser tattoo removal: tattoo pigment in lysosomes vaporized, cell destroyed, extracellular phagocytosis and lymphatic clearance of pigment

Tattoos and Lasers

Tattoo color	Compound	Laser to treat	Comments
Red	Mercuric oxide, sulfide	PDL 510, QS FD Nd:YAG	Allergic rxn
Green	Chromium salts	QS Ruby, QS Alexandrite	Allergic rxn
Yellow	Cadmium sulfide		Phototoxic rxn
Black	Carbon	QS Nd:YAG	
Brown	Iron oxide		Beware: Reduced form instantaneous darkening
Dark Blue	Cobalt	QS Ruby, QS Alexandrite	Allergic rxn
Light Blue	Manganese		
White	Titanium oxide		Beware: Reduced form instantaneous darkening

Cosmetic Fillers

Categories:

1. Autologous: Lipotransfer
   - No risk of rejection; harvesting procedure, fat may be frozen 12-18 months, fat graft survival: 0-80%
2. Xenograft: Bovine collagen, hyaluronic acid
   - *Zyderm I, Zyderm II, Zyplast*
3. Allograft: Human tissue culture
   - *Cosmoderm, Cosmoplast, Dermalogen, Cymetra, Fascian*
4. Synthetic substances
   - Polytetrafluoroethylene

Cosmetic Fillers

Bovine Collagen

- Zyderm I (35 mg/dl), Zyderm II (65 mg/dl), Zyplast
- 98% Type I and 2% Type III collagen, in saline and lido
- Zyderm lasts 3 months, used for superficial wrinkles
- Zyplast crosslinked with glutaraldehyde, lasts longer, less immunogenic, used for deeper creases
- 3% patients hypersensitive, so perform “Double Skin Testing” using Zyderm I. Test at 0 and 2 weeks w/ small subcutaneous injection.
- Rare complications: granuloma, sterile abscess

Cosmetic Fillers

Hyaluronic Acid

- Natural occurring polymer polysaccharide of glucuronic acid and N-acetyl glucosamine
- Chemical composition same between species
- Lasts 6 months
- Hylaform (Hylan B gel): derived from rooster combs
- Restylane, Perlane: fermentation product of Streptococcus

Cosmetic Fillers

Human Collagen

- No skin testing necessary
- Cosmoderm (superficial dermis), Cosmoplast (deep); dervied from cell culture of human foreskin fibrocytes
- Others: Cymetra, Isolagen, Autologen, Fascian

Botulinum Toxin

- Polypeptide derived from *Clostridium botulinum*
- Seven serotypes (A-G), BTX-A used in dermatology
- Applications: Facial lines, brow ptosis, hyperhidrosis
- Mechanism: inhibits release of acetylcholine from pre-synaptic terminal at NMJ; heavy chain of BTX binds presynaptic receptors allowing endocytosis of light chain, causing degradation of docking and fusion machinery
- Adverse effects: does not cross blood-brain barrier, ptosis, ectropion, diplopia
- Drug interactions: potentiated by aminoglycosides, blocked by antimalarials

Dermabrasion

- Removal of epidermis and papillary dermis with a motorized wire brush or diamond fraise
- Uses: acne scars, traumatic scars, photodamage, wrinkles, AKs, SKs, rhinophyma, syringomas, small cysts, tattoos
- Contraindications: isotretinoin within past year, surgery within past year involving extensive undermining, keloid diathesis, active HSV or bacterial infection
- Post-op: reepithelialization 5-7 days, persistent erythema 4-8 weeks, sun protection necessary
- Microdermabrasion: Aluminum oxide or sodium chloride microcrystals used to remove epidermis

Chemical Peels

- Uses: shallow rhytids, photodamage, acne scarring, AKs, SKs, freckles, lentigines, melasma
- Ideal patient light skin; avoid neck (scarring); acyclovir prophylaxis if history of HSV
- Superficial: Granular layer / papillary dermis
  - TCA 10-25%, resorcinol, Jessner's, salicylic acid, alpha-hydroxy acids, dry ice, tretinoin
- Medium: Papillary dermis / upper reticular dermis
  - Phenol 88% or combination peels of 35% TCA + (CO_2, Jessner's, glycolic acid). Phenol associated w/ CARDIAC ARRHYTHMIAS
- Deep: Mid-reticular dermis
  - Baker's phenol-croton oil.

Hair Removal

- Temporary Methods:
  - Plucking/Waxing/Epilation: safe, lasts 6-8 weeks, irritation
  - Chemical depilation: thioglycolates disrupt disulfide bonds, lasts 2 weeks, irritation & sulfurous odor; useful for PFB
  - Eflornithine (Vaniqa) cream: inhibits ornithine decarboxylase, FDA approved for facial hair in women
- Permanent Methods:
  - Electrolysis: needle inserted into hair follicle and DC or AC current applied to destroy matrix, best results 15-25% regrowth after 6 months, painful, caution pacemakers and hx of HSV
  - Laser: selective photothermolysis of melanin in matrix, ideal patient light skin & dark hair, risks: PIPA / pain / scarring

Practice Questions

Match the laser and wavelength:

1) Nd:YAG	A. 585 nm
2) PDL Yellow	B. 755 nm
3) Alexandrite	C. 1064 nm
4) CO2	D. 2940 nm
5) Erb:YAG	E. 10,600 nm

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1. Temporal (unilateral eyebrow ptosis)

2. Marginal Mandibular (oral incontinence)

What is the maximum volume of 1% lidocaine without epinephrine that can be given to a 60 kg adult?

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60 kg x 5 mg/kg = 300 mg = 30 mL

Which suture material is most appropriate for use on mucosal surfaces?

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Silk.

Which type of suture needle has a greater risk of tearing through the skin, cutting or reverse cutting?

Which type of suture needle has a greater risk of tearing through a skin wound edge, cutting or reverse cutting?

Cutting.

Which of the following sites is best for second intention healing?

A. Forehead

B. Nasal tip

C. Medial canthus

D. Chin

E. Lower eyelid

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Match the flap with its type:

1) O-Z	A. Advancement
2) Island pedicle	B. Rotation
3) Bilobed	C. Transposition
4) Z-plasty	D. Inversion
5) Perialar crescentic	E. Transalignment

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A. Undampened waveform

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C. Highly dampened waveform

D. Accelerated waveform

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A. 4 mm

B. 5 mm

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D. 1 cm

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Match the spectrum with the wavelength:

1) UVA2	A. 200-280 nm
2) UVC	B. 280-320 nm
3) UVB	C. 320-340 nm
4) Infrared	D. 400-700 nm
5) Visible	E. 700-10^5 nm

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B. Nd:YAG
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D. Excimer
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A. Collagen I
B. Collagen II
C. Collagen III
D. Collagen I + II
E. Collagen I + III

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B. Diode
C. Argon
D. Erb:YAG
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Which of the following color tattoos is associated with immediate adverse darkening with laser treatment?

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B. Blue
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A. Isotretinoin within past year
B. Recent surgery with undermining in area of treatment
C. Keloid diathesis
D. Active HSV infection
E. All of the above

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EMLA (Eutectic Mixture of Local Anesthetics) consists of which of the following?

A. Lidocaine + Procaine
B. Lidocaine + Marcaine
C. Lidocaine + Prilocaine
D. Lidocaine + Tetracaine
E. Procaine + Prilocaine

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Parietal emissary vein.

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Cadmium sulfide (yellow).

Which of the following lasers is most likely to damage the cornea?

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B. Frequency-doubled QS Nd:YAG
C. Argon
D. Erb:YAG
E. Pulse Dye Green

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D. Erb:YAG

E. Pulse Dye Green

Damage to which nerve causes shoulder droop? Where does this nerve emerge?

Damage to which nerve causes shoulder drop? Where does this nerve emerge?

Spinal accessory nerve (CN XI). It emerges from the posterior triangle of the neck at Erb's point.

Which of the following regional blocks is used to produce anesthesia of the upper lip?

A. Supratrochlear
B. Infratrochlear
C. Infraorbital
D. Mental
E. Buccal

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