Mohs Surgery
and
Reconstruction after Mohs Surgery

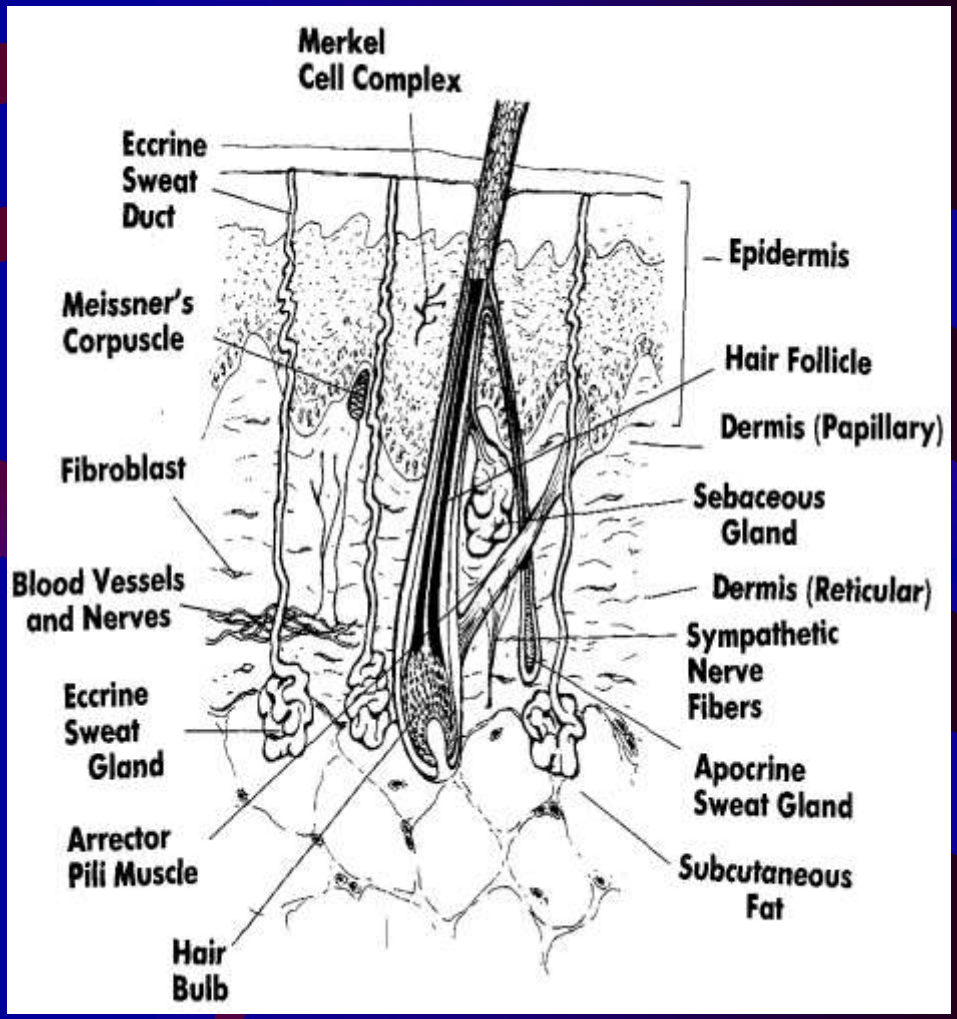
Edward D. Buckingham, MD
Faculty Advisor: Karen H. Calhoun, MD
The University of Texas Medical Branch
Department of Otolaryngology
Grand Rounds Presentation
November 10, 1999

Introduction

- 500,000 new nonmelanoma skin CA treated annually in U.S.
- More than 80% in head and neck
- Most treated with standard therapy, such as cryosurgery, electrodessication
- Subset result in significant functional and cosmetic morbidity
- Difficult tumors best treated with Mohs surgery

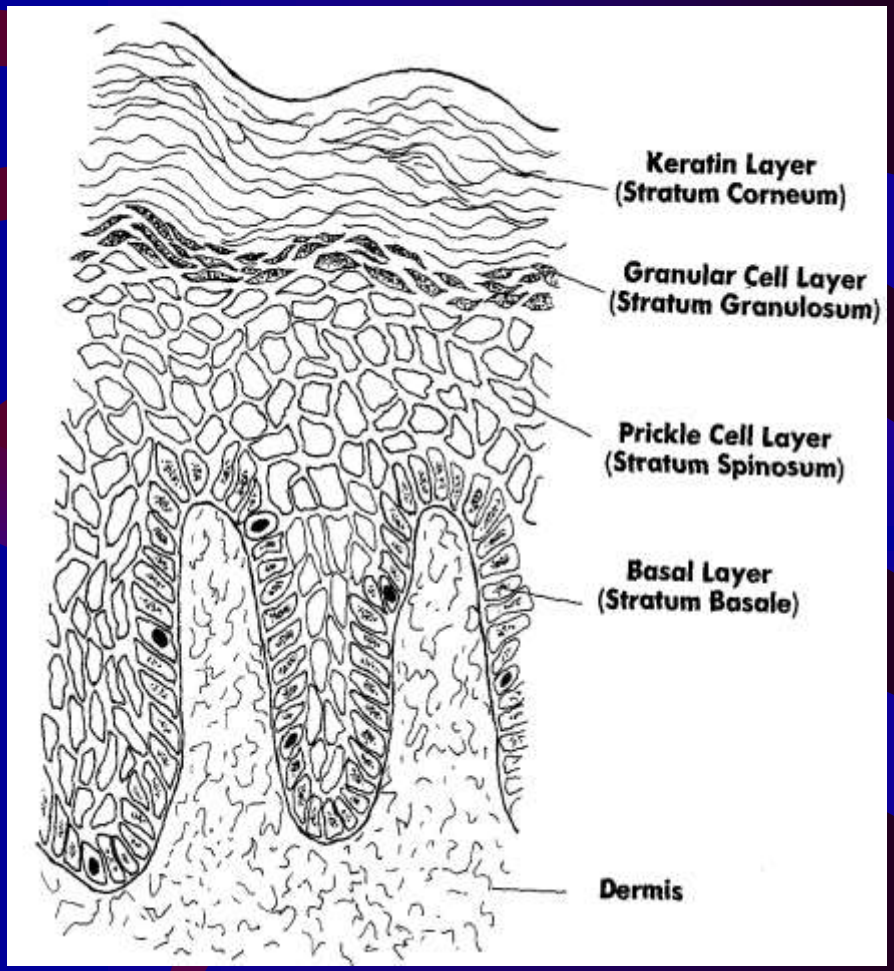
Skin Anatomy - General

- Composed of epidermis and dermis
- Smooth non-hair bearing (glabrous)
- Hair bearing (nonglabrous)



Skin - Epidermis

- Keratinizing stratified squamous epithelium
- Four cell types, keratinocytes, melanocytes, Langerhans cells, Merkel cells
- Keratinocytes make up the bulk of epidermis
- Four layers



Skin - Melanocytes

- Neural crest origin, basal layer
- 1:4 to 1:10 melanocyte to basal cell ratio
- Function to produce melanin > melanosomes
- # melanocytes not different between races
- Increase in melanosomes in darker skinned races

Skin - Melanocytes

- Vitiligo melanocytes absent
- Albinism melanocytes present but lack tyrosinase
  - cannot convert tyrosine to melanin

Skin - Langerhan Cells

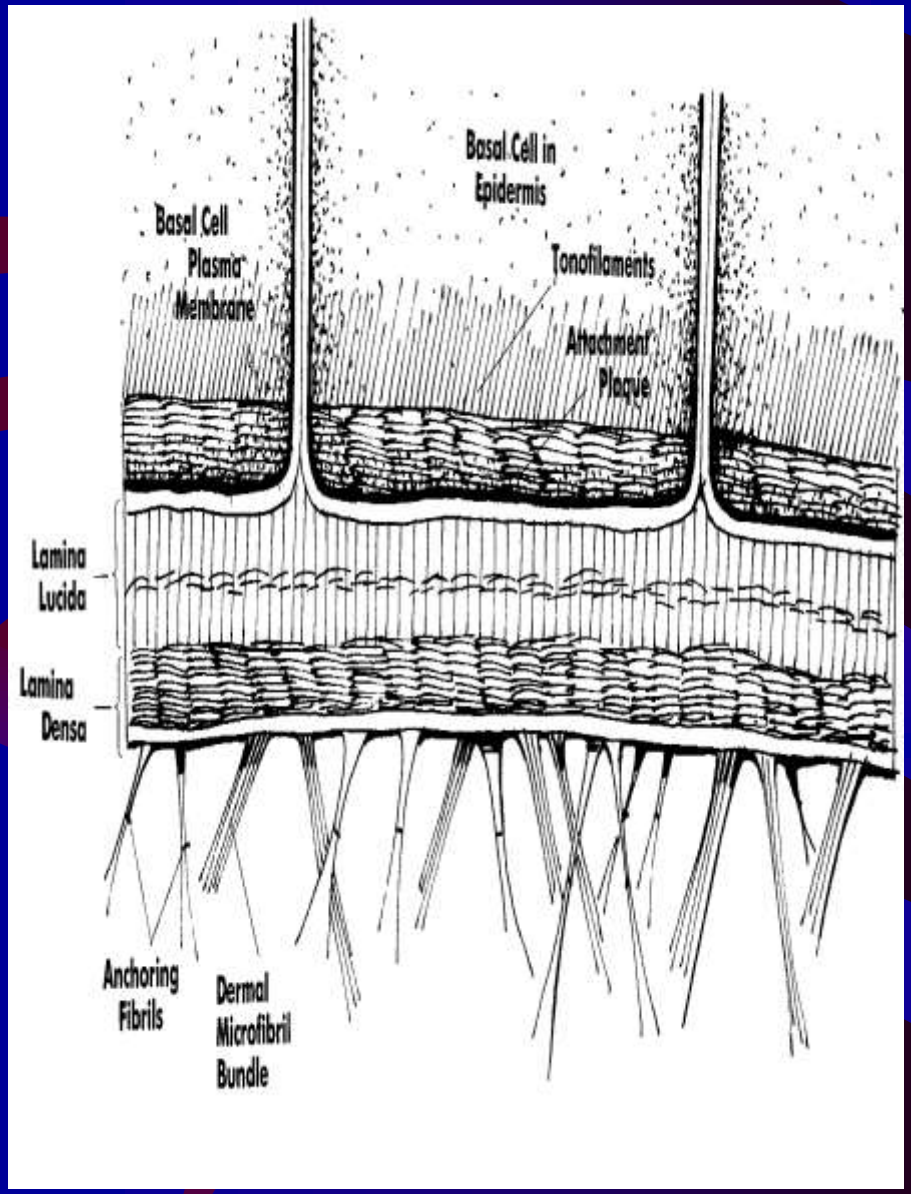
- Found in suprabasilar epidermis, stratum spinosum
- Mediators of immunologic response

Skin - Merkel Cells

- Found in epidermis and dermis
- Close assoc. with peripheral nerve endings
- Thought to be slowly adopting touch receptors, function unclear
- Merkel cell tumors thought to arise from

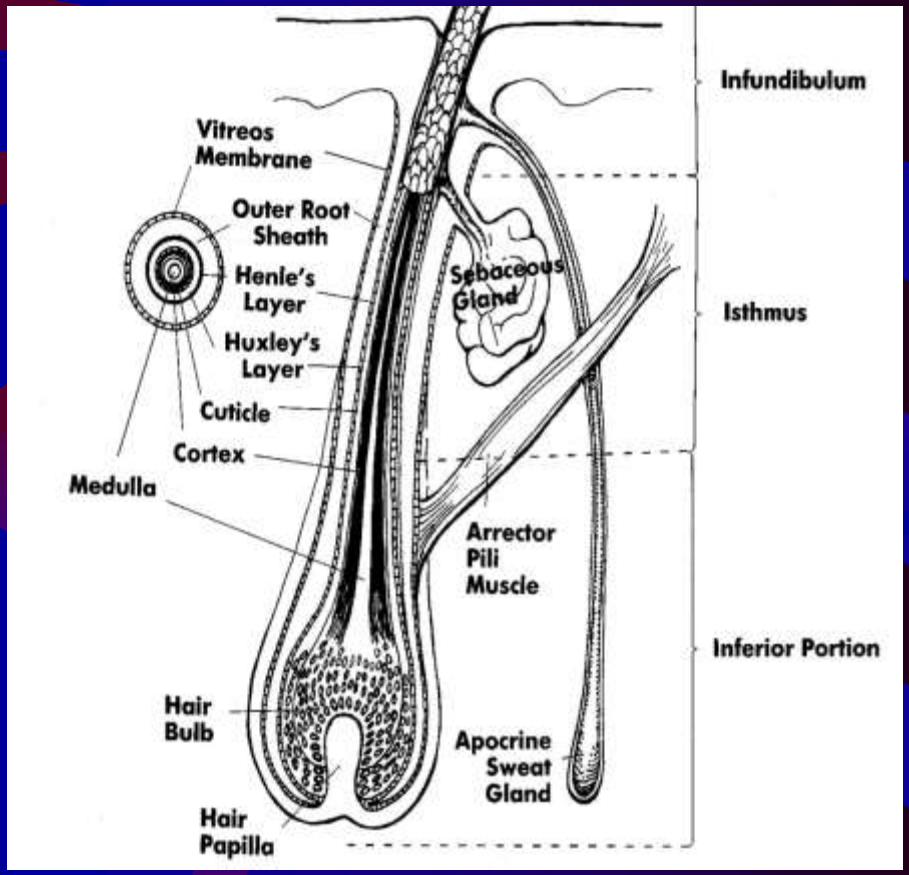
Skin - Basement membrane zone

- Epidermis attaches to dermis
- Tonofilaments in basal cell condense and attach to electron dense area, attachment plaque, unit known as hemidesmosome
- Firmly anchored to underlying lamina densa through connecting anchoring filaments in the lamina lucida



Skin - Pilosebaceous unit

- Contains hair follicle, Apocrine sweat gland, Sebaceous gland
- Responsible for epidermal buds in split thickness skin grafts



Skin - Dermis

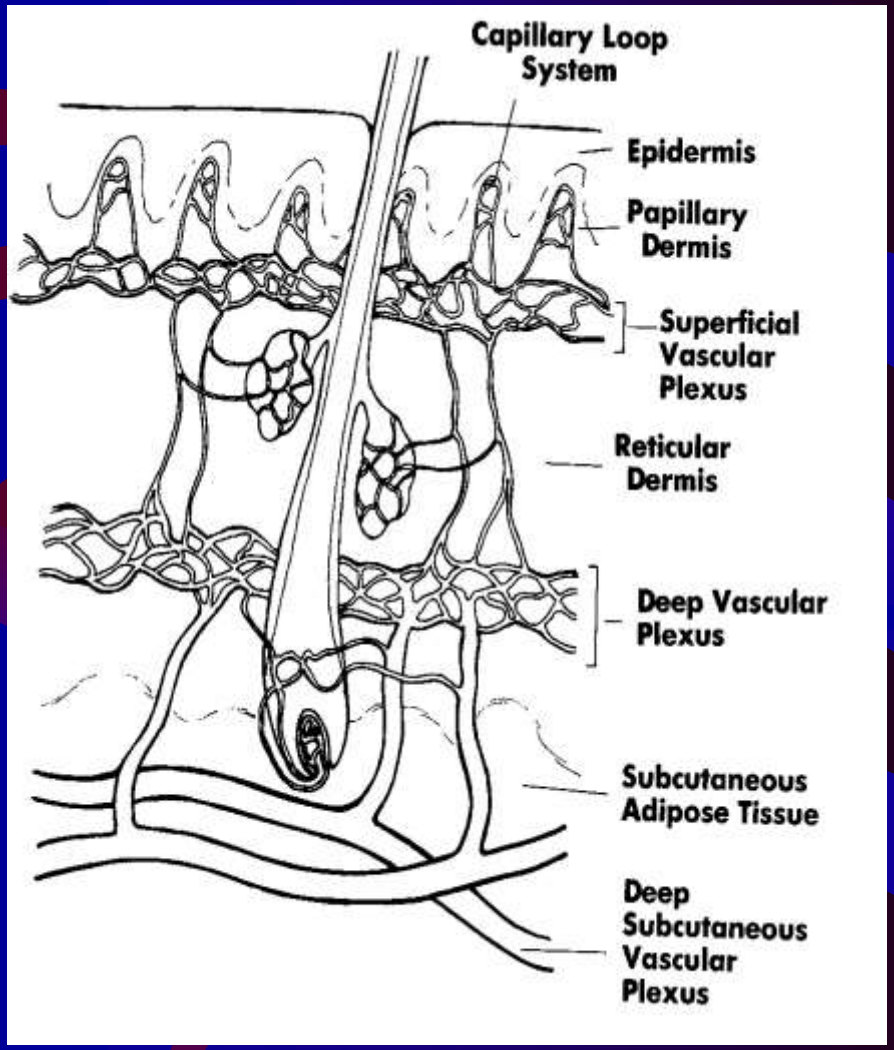
- Primary cell fibroblast
- Superficial papillary dermis
- Deep reticular dermis
- Fibrous connective tissue of collagen, elastin, groundsubstance (fibronectins, glycosoaminoglycans)

Skin - Dermis

- Collagen decreases 1%/yr in adulthood
- UV light may stimulate keratinocytes to produce IL-1, stimulate collagenase
- Topical tretinoin increases density of anchoring fibrils, poss inhibiting collaganase

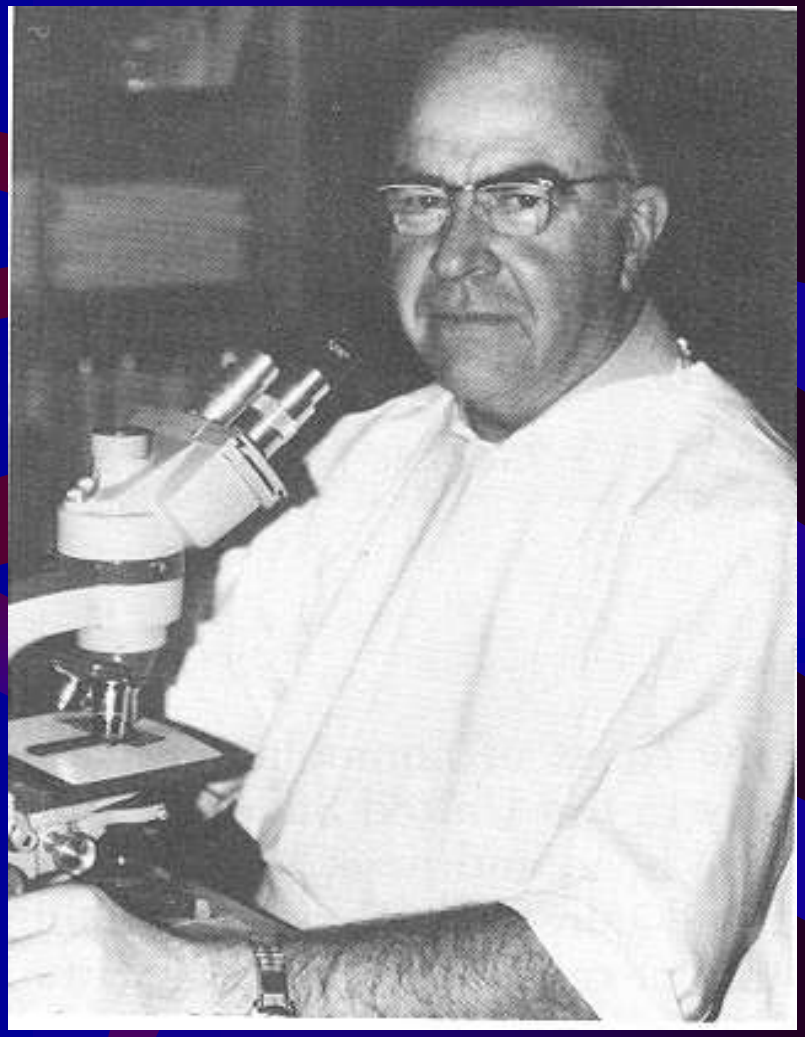
Skin - Vascular Supply

- Two vascular plexuses
- Superficial - rich capillary loop system in the superficial dermal papillae
- Deep - junction of dermis and subcutaneous fat
- Connected by communicating vessels in reticular dermis



Mohs procedure - History

- 1930's Frederick E. Mohs
- In vivo chemical fixation - zinc chloride fixative paste
- 99% 5-year cure rate primary BCCA
- 96% 5-year cure rate for recurrent BCCA
- Procedure took several days



Mohs procedure - History

- Postoperative slough - several weeks
- Delayed or no reconstruction
- 1953 fresh tissue technique, eyelid cancer
- 1970 Theodore Tromovitch, 75 cases ACCS, advantages became clear

Mohs surgery - History

- “tissue sparing in tumor extirpation is maximized while maintaining high cure rates, and appropriate functional and cosmetic reconstruction can be performed immediately.”
- Nomenclature 1986 - Mohs micrographic surgery, fresh-tissue technique; Mohs micrographic surgery, fixed-tissue technique

Mohs surgery - Technique

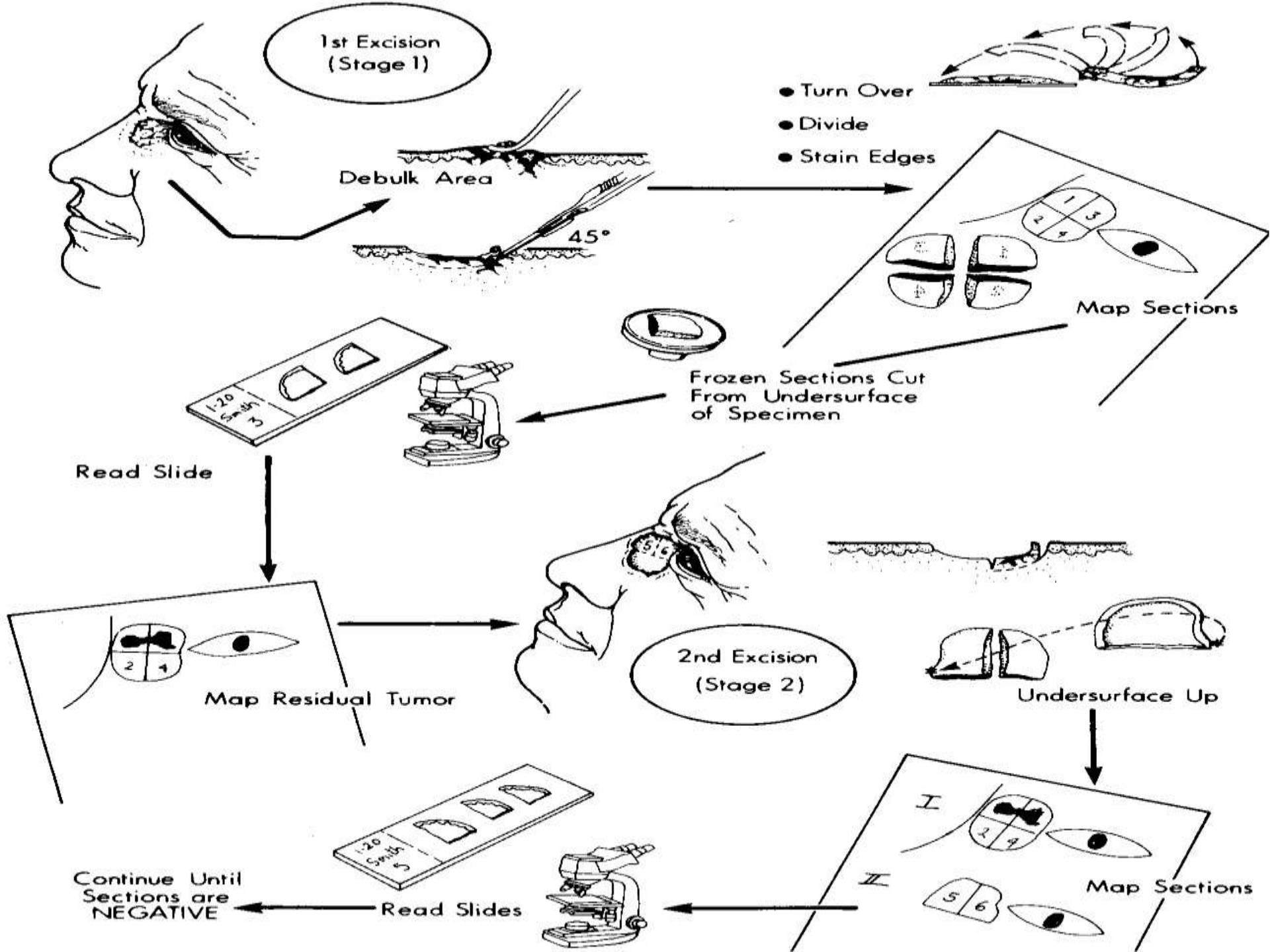
- Diagnosis and histologic type established with skin biopsy and conventional permanent histology
- Majority of excisions done under local anesthesia
- Clinical tumor outlined
- De-bulked with dermal curet
- Saucer shaped layer of tissue taken around and under clinically apparent tumor with narrow margins

Mohs surgery - Technique

- 45 degree bevel of skin incision extremely important
- Specimen oriented relative to patient
- Map drawn of patient and specimen
- Specimen divided into appropriate sized pieces for processing
- Compressed so that epidermal edge lies in same plane as dermal edge and deep margins

Mohs surgery - Technique

- Frozen and horizontally sectioned
- 100% of peripheral and deep margins visualized
- Any residual tumor mapped to patient and 2nd excision performed
- Repeated until all tumor cells removed


1st Excision
(Stage 1)
Debulk Area
45°
• Turn Over
• Divide
• Stain Edges
Map Sections
Frozen Sections Cut
From Undersurface
of Specimen
Read Slide
Map Residual Tumor
2nd Excision
(Stage 2)
Undersurface Up
Map Sections
Read Slides
Continue Until
Sections are
NEGATIVE

Mohs surgery - Indications

Table 1. *Indications for Mohs Micrographic Surgery*

Recurrent skin cancer*
Skin cancer in a "high risk anatomic area"
Histologically aggressive skin cancer
Large skin cancer
Skin cancer with ill-defined clinical margins
Incompletely excised skin cancer
Skin cancer in irradiated skin
Skin cancer in a cosmetically important area
Dermatofibrosarcoma protuberans
Selected mucosal squamous cell carcinomas

* Skin cancer refers to basal cell and squamous cell carcinoma only.

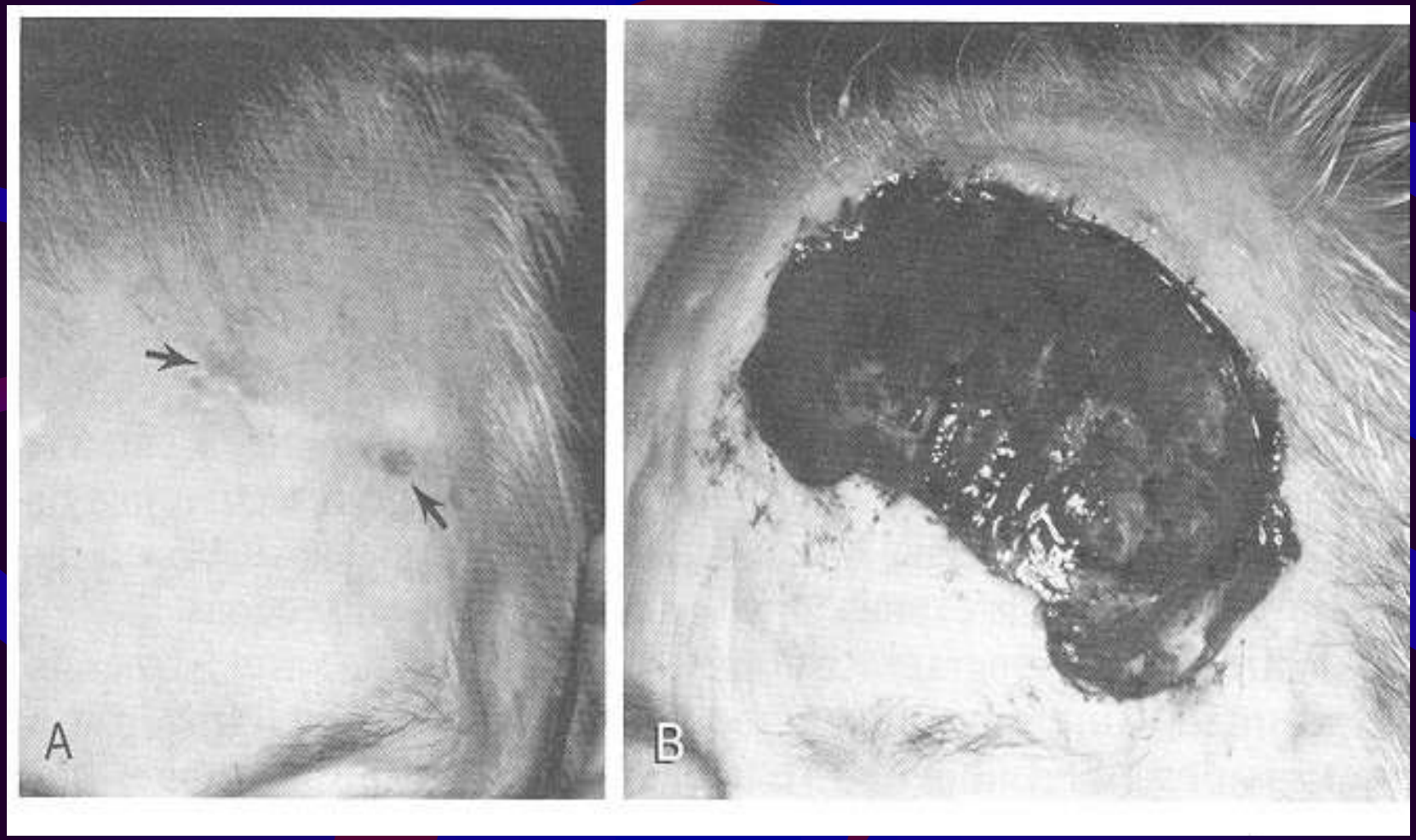
Mohs surgery - Recurrent BCCA

Table 2. *Recurrence Rates for the Treatment of Recurrent Basal Cell Carcinoma*

Electrodesiccation and curettage[38, 67]	40 %–59 %
Cryosurgery (short-term data only)[67]	8 %–19 %
Radiation therapy[38, 67]	9 %–51 %
Surgical excision[38, 67]	5 %–40 %
Mohs micrographic surgery[44, 60]	3 %–8 %

Except for cryosurgery, the data refers to studies with at least 5-year follow-up.

Mohs surgery - Recurrent BCCA

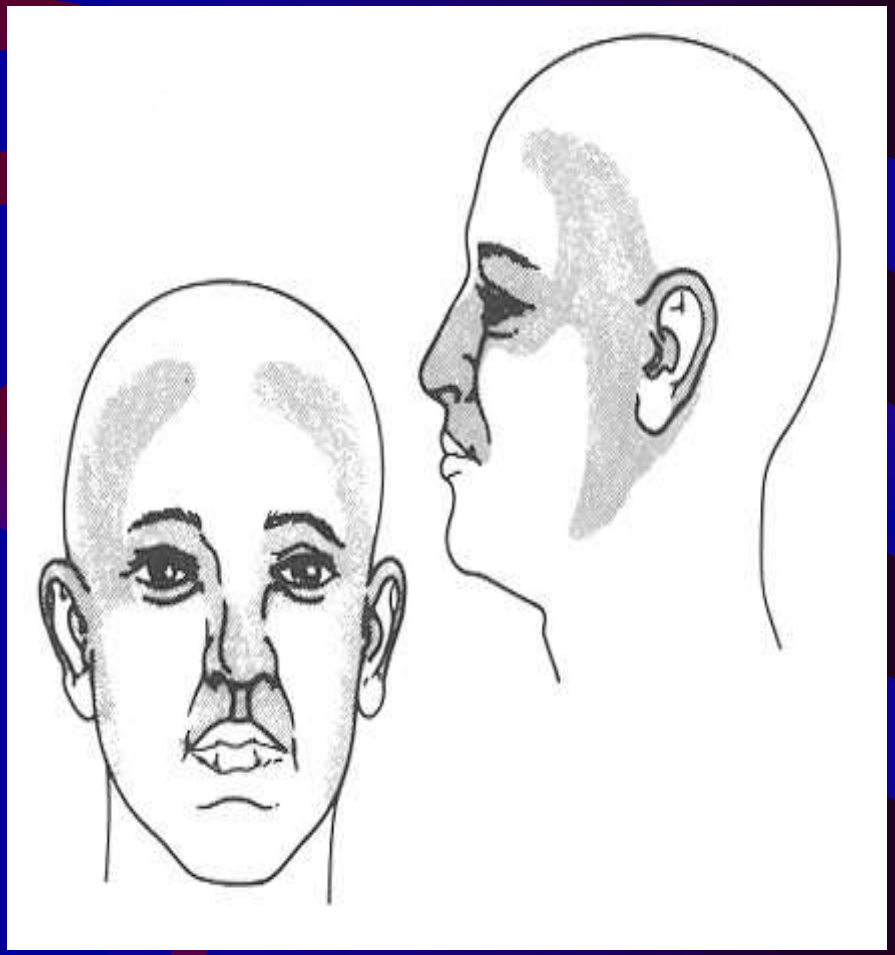


Mohs surgery - BCCA High - risk anatomic locations

- Different from cosmetically important area
- Spread path of least resistance; dermis, fascial planes, embryonic fusion planes, perichonduium, periosteum, neurovascular bundles

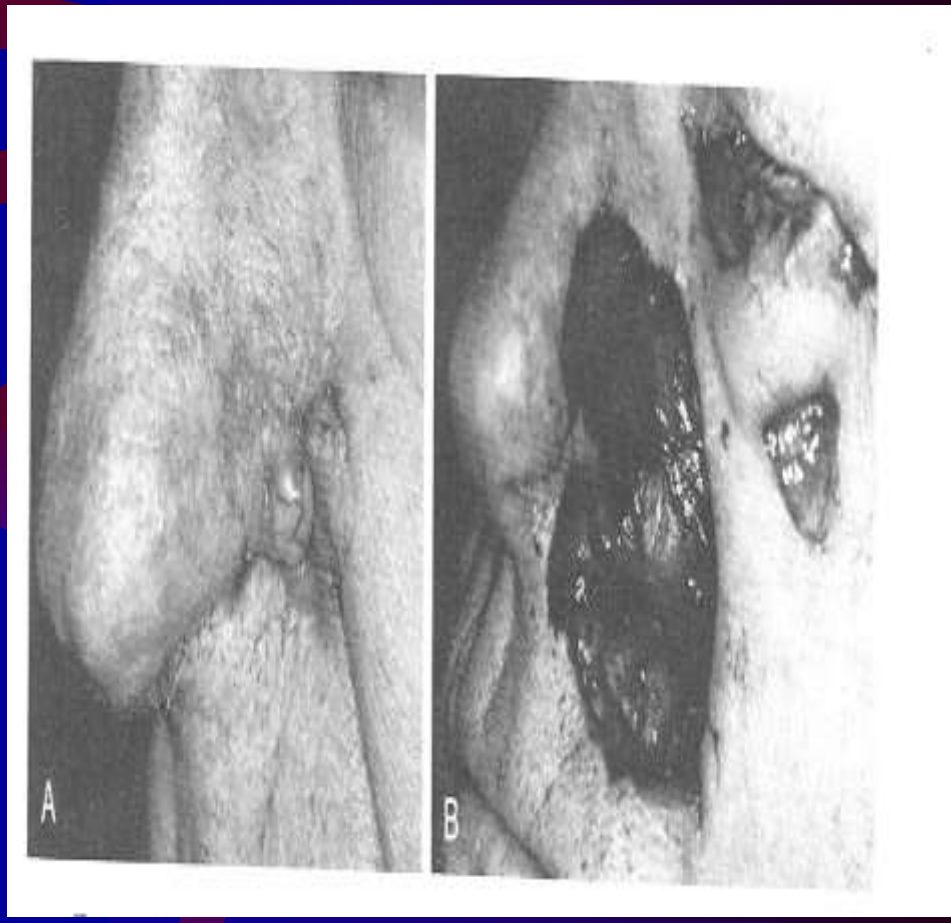
Mohs surgery - BCCA High - risk anatomic locations

- High risk areas - “H” zone - nasal ala, nasal septum, nasal ala groove, periorbital region, periauricular region, region around and in ear canal, ear pinna, and scalp



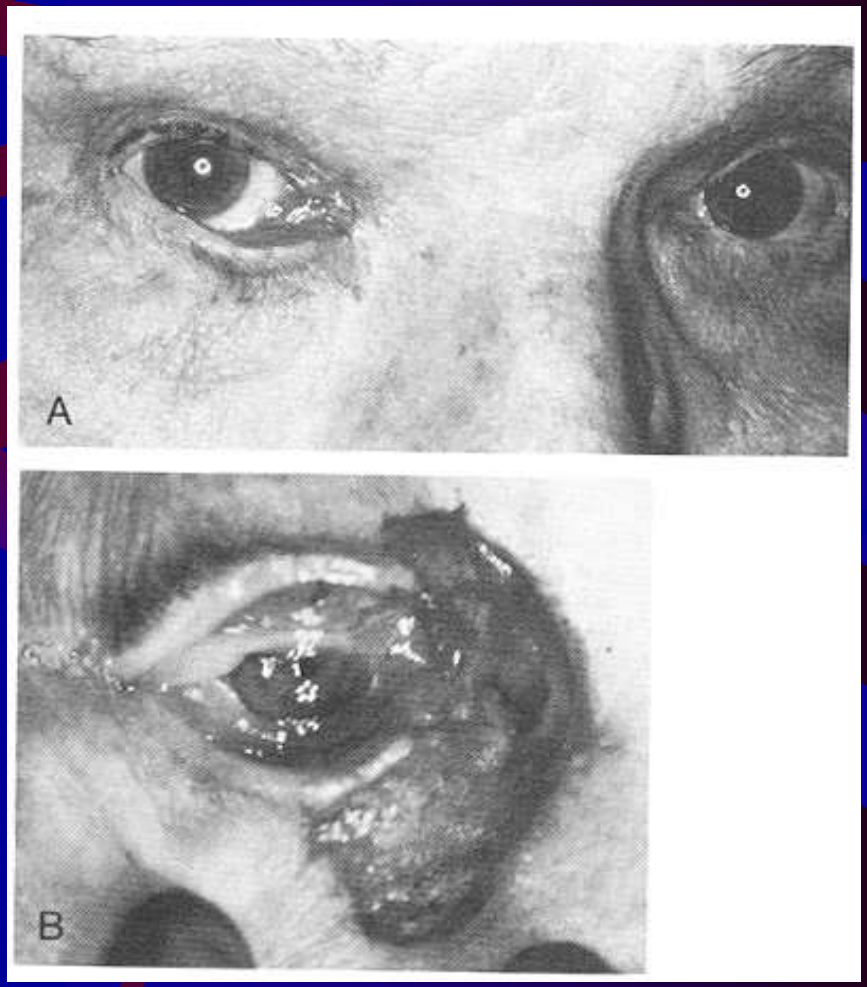
Mohs surgery - BCCA High - risk anatomic locations

- Nasal ala and ear pinna silent perichondrial spread
- periauricular and nasal ala groove regions deep invasion along embryonic fusion planes



Mohs surgery - BCCA High - risk anatomic locations

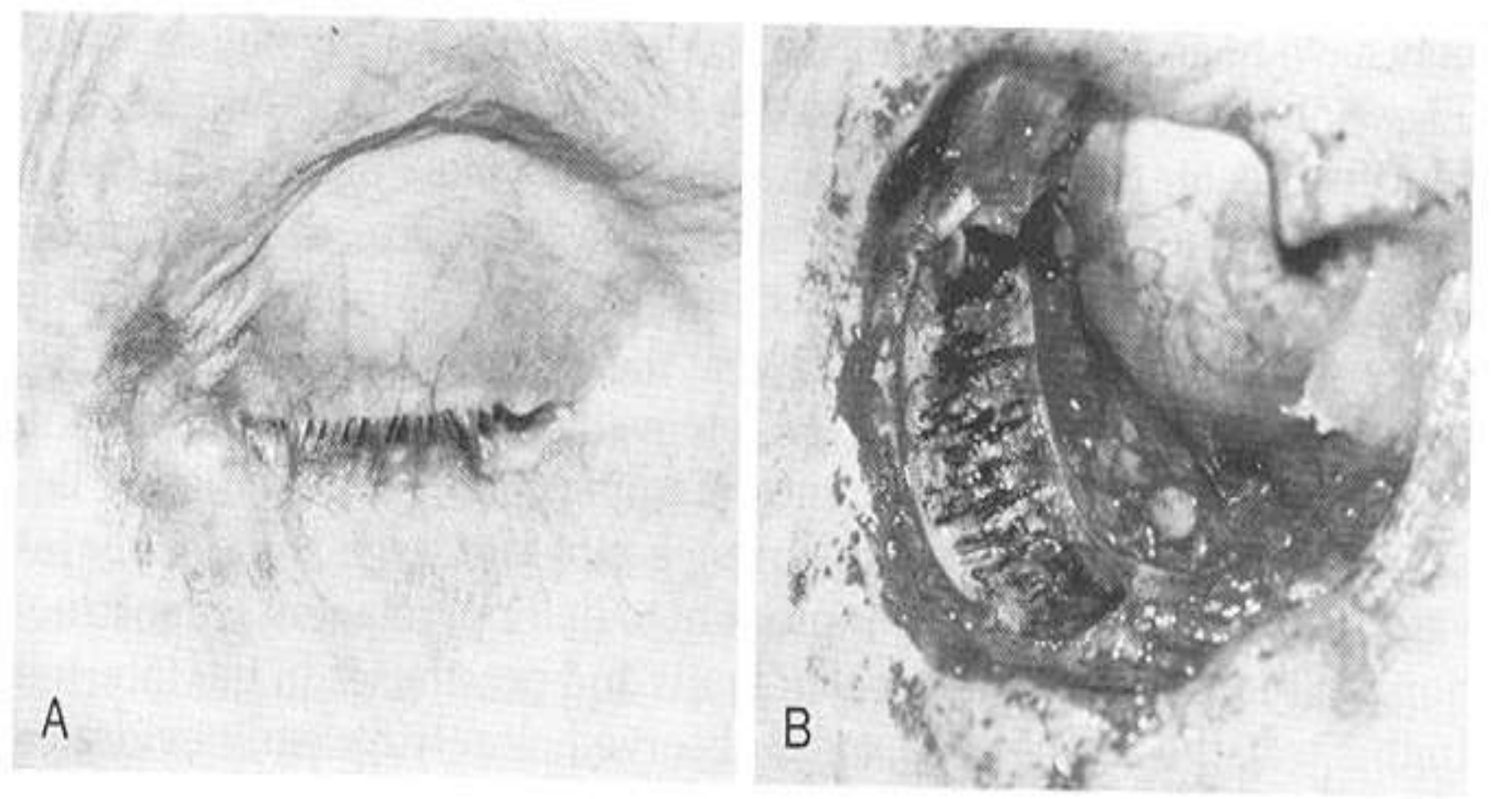
- Medial canthus extrmemly invasive, extending into lacrimal system, periosteum deep into orbit, lead to orbital exenteration and brain invasion
- Eyelid extend along conjunctival surface of tarsal plate



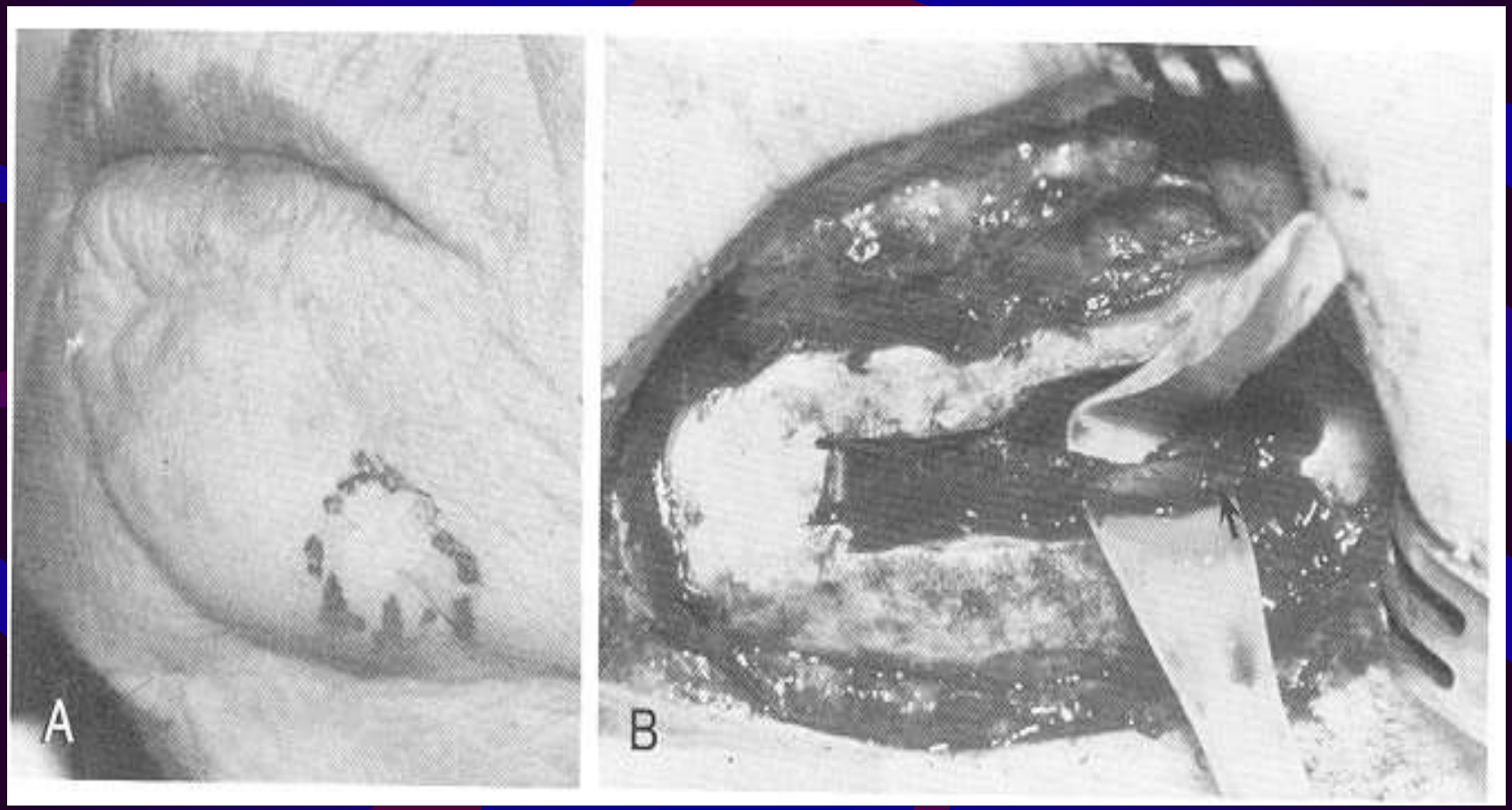
Mohs surgery - Histologically Aggressive BCCA

- Common types noduloulcerative and superficial types treatable with conventional therapy
- Morpheaform, sclerosing, infiltrating, or keratinizing (metatypical and basosquamous) much more invasive
- Series of 51 morpheaform BCCA avg. subclinical extension of 7.2 mm from clinical tumor

Mohs surgery - Histologically Aggressive BCCA



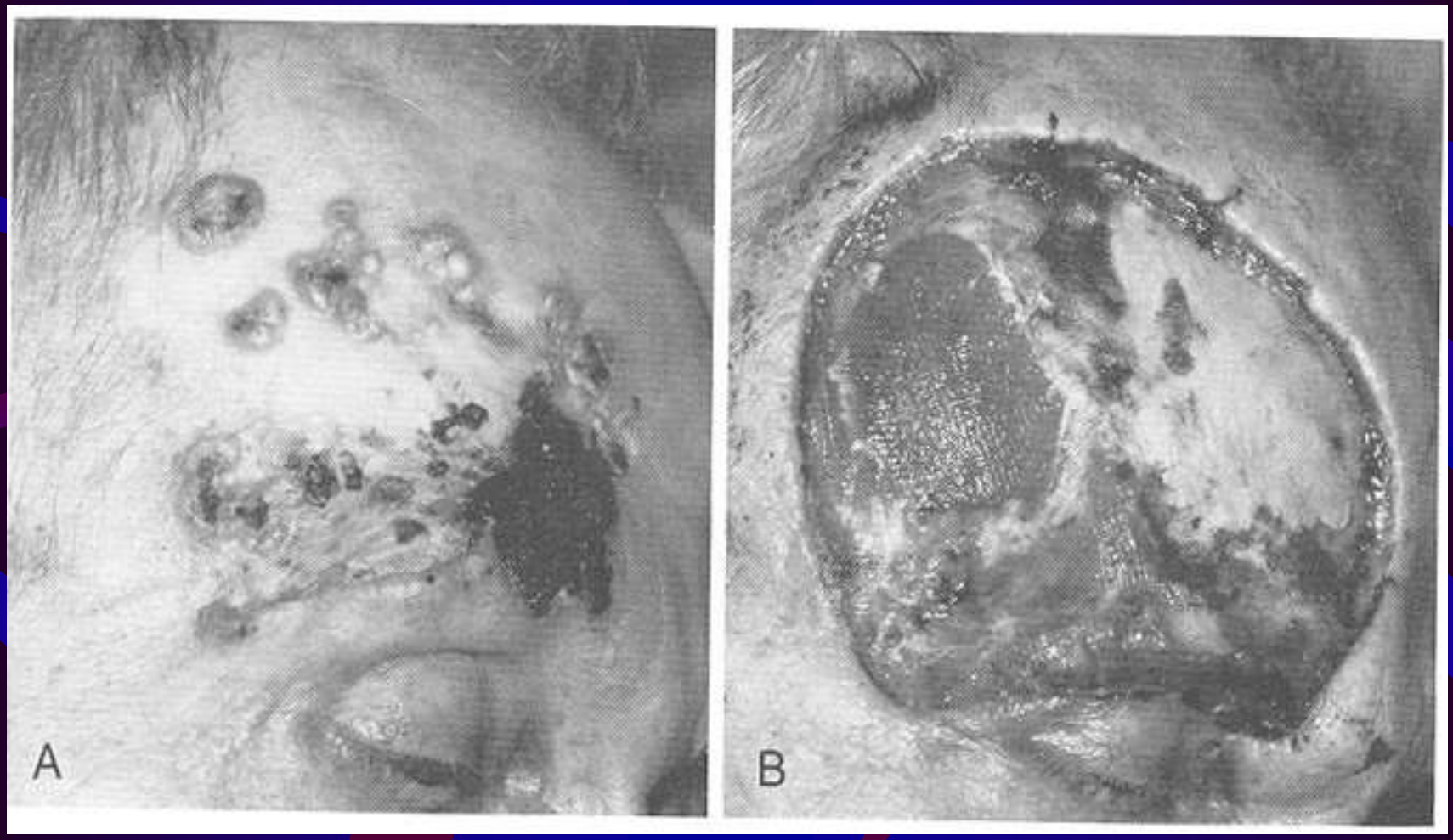
Mohs surgery - Histologically Aggressive BCCA



Mohs surgery - Large sized skin cancers

- Mohs surgery 5 yr cure 99% BCCA < 3 cm, 93% BCCA >3 cm,
- SCCA cure rates lower
- Maximum tissue preservation, reasonable assurance of tumor-free margins
- Prudent to use skin grafts to reconstruct to monitor tumor bed, permanent recon in 1-2 yrs

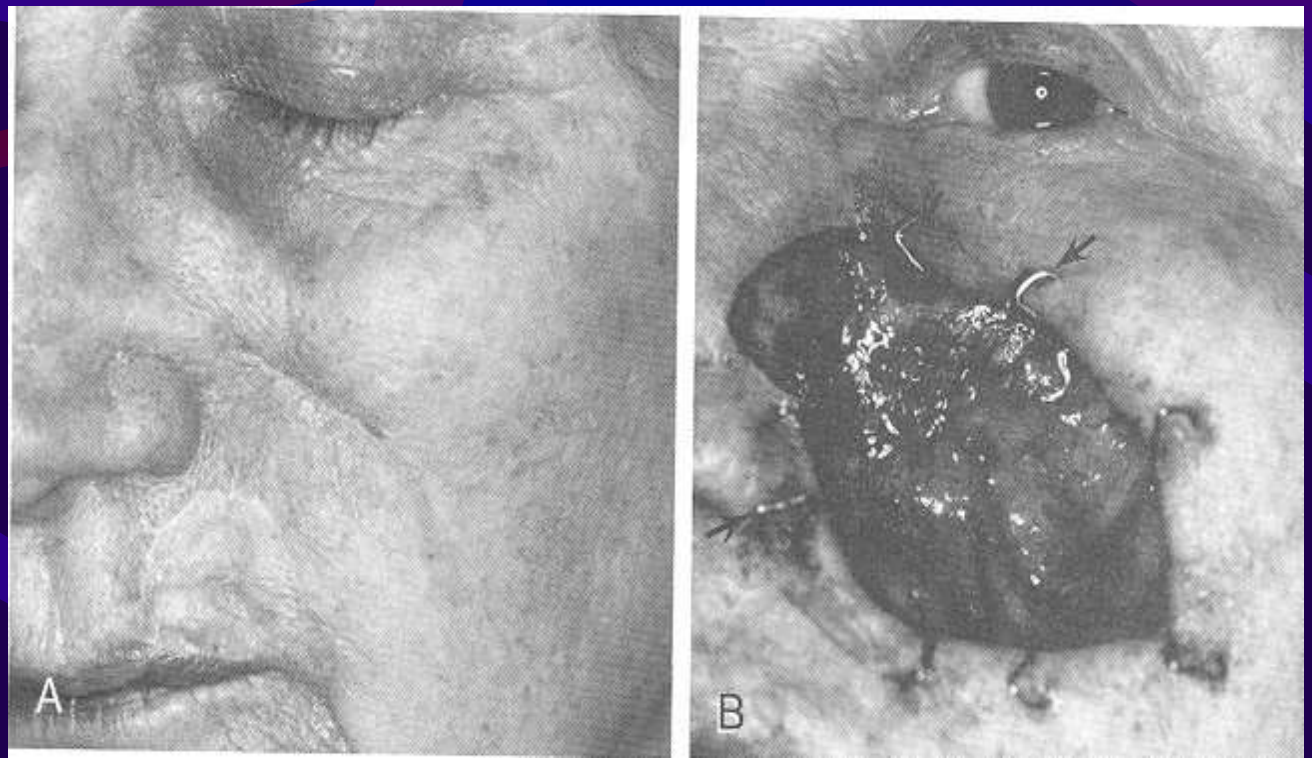
Mohs surgery - Large sized skin cancers



Mohs surgery - Ill defined margins

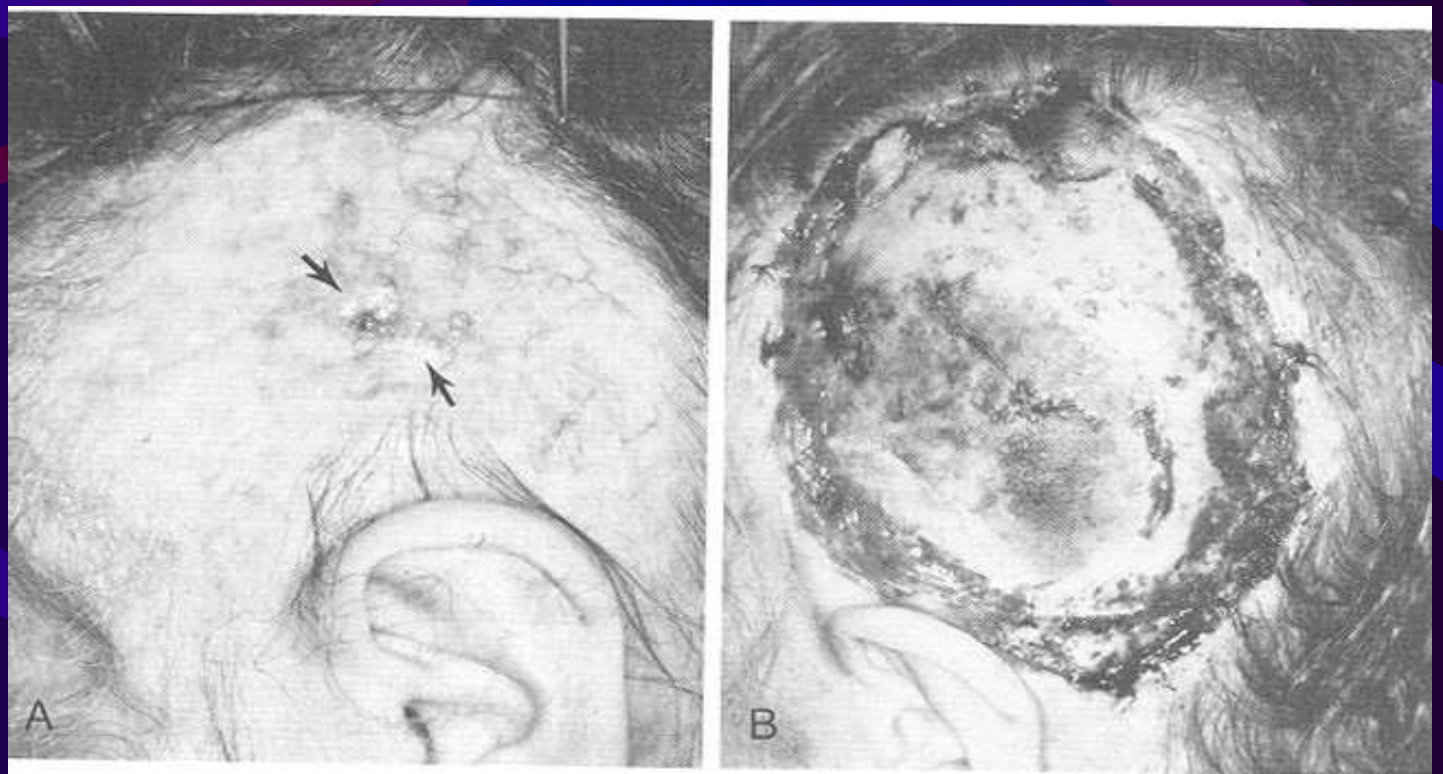
Mohs surgery - Incompletely excised BCCA

- Margins positive recur 33 % within 2 yrs
- Margin within one HPF recurrence 12 %



Mohs surgery - Carcinomas in irradiated skin

- Increased incidence of SCCA and BCCA
- Tend to have indistinct clinical margins, histiologically aggressive



Mohs surgery - Cosmetically important areas

- nasal tip, nasal ala, nasal bridge, upper lip, ear pinna, eyelid, eyebrow, fingers, toes, genitalia

Table 3. *Recurrence Rates for the Treatment of Primary Basal Cell Carcinoma*

Electrodesiccation and curettage[66]	8 %
Cryosurgery[66]	8 %
Radiation therapy[66]	9 %
Surgical excision[66]	10 %
Mohs micrographic surgery[44, 60, 66]	1 %

Includes studies with at least 5-year follow-up.

Mohs surgery - new and controversial use

- Dermatofibrosarcoma protuberans (DFSP)
  - 15% reported in H&N
  - 49% recurrence with conventional excision
  - Even with 3 cm margins 11 % recurrence
  - Several encouraging reports, jury out
- Malignant Melanoma
  - “most Mohs surgeons feel melanoma should be excised with 1-3 cm margins depending on Breslow tumor thickness, and that Mohs surgery does not provide any benefit

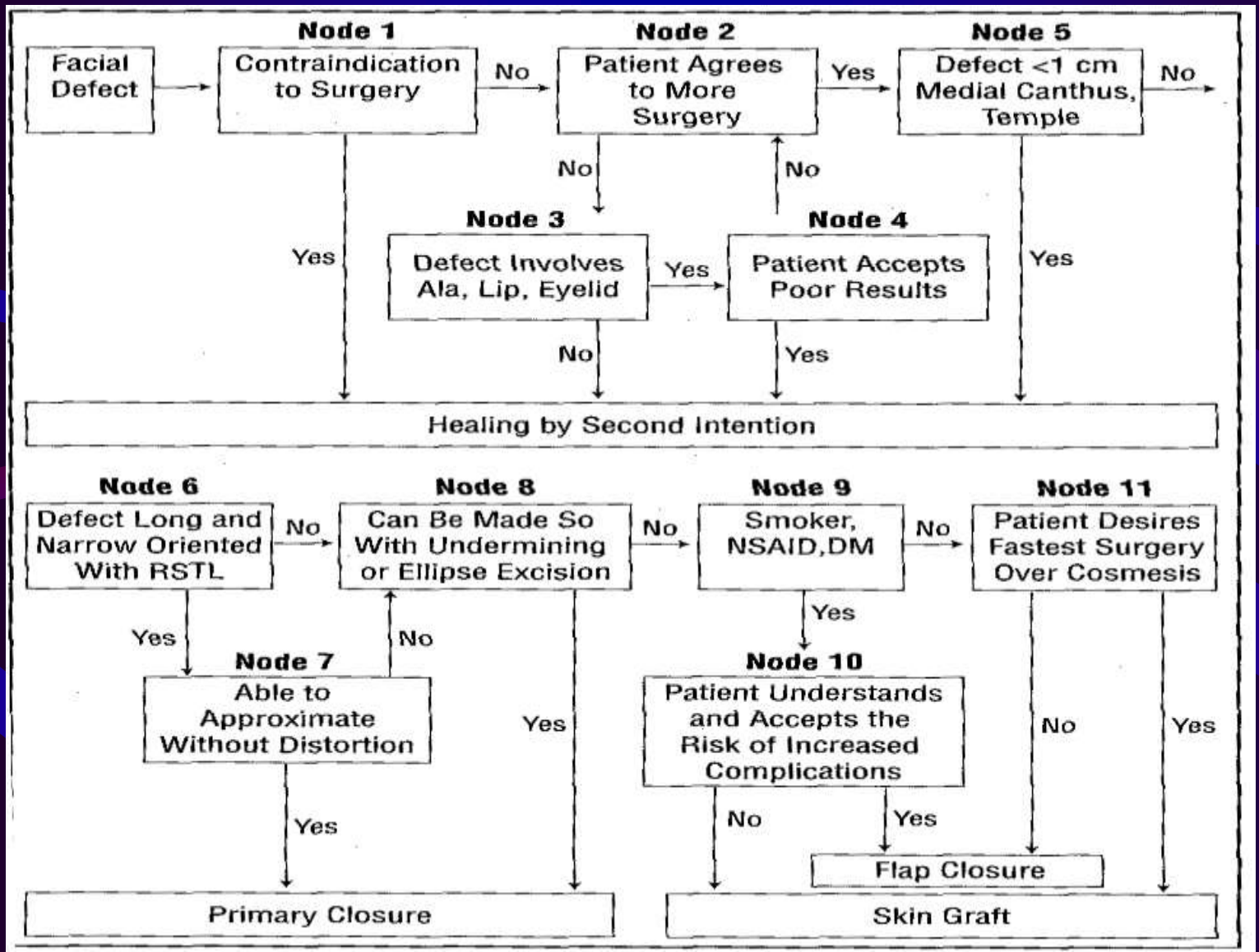
Mohs surgery - new and controversial use

- H&N Mucosal SCCA
  - Some good local control and regional/distant control rates reported
  - Not commonly used

Reconstruction after Mohs - Options

- Heal by secondary intention, primary closure, skin grafts, local flaps, regional flaps, distant flaps, free flaps, tissue expanders

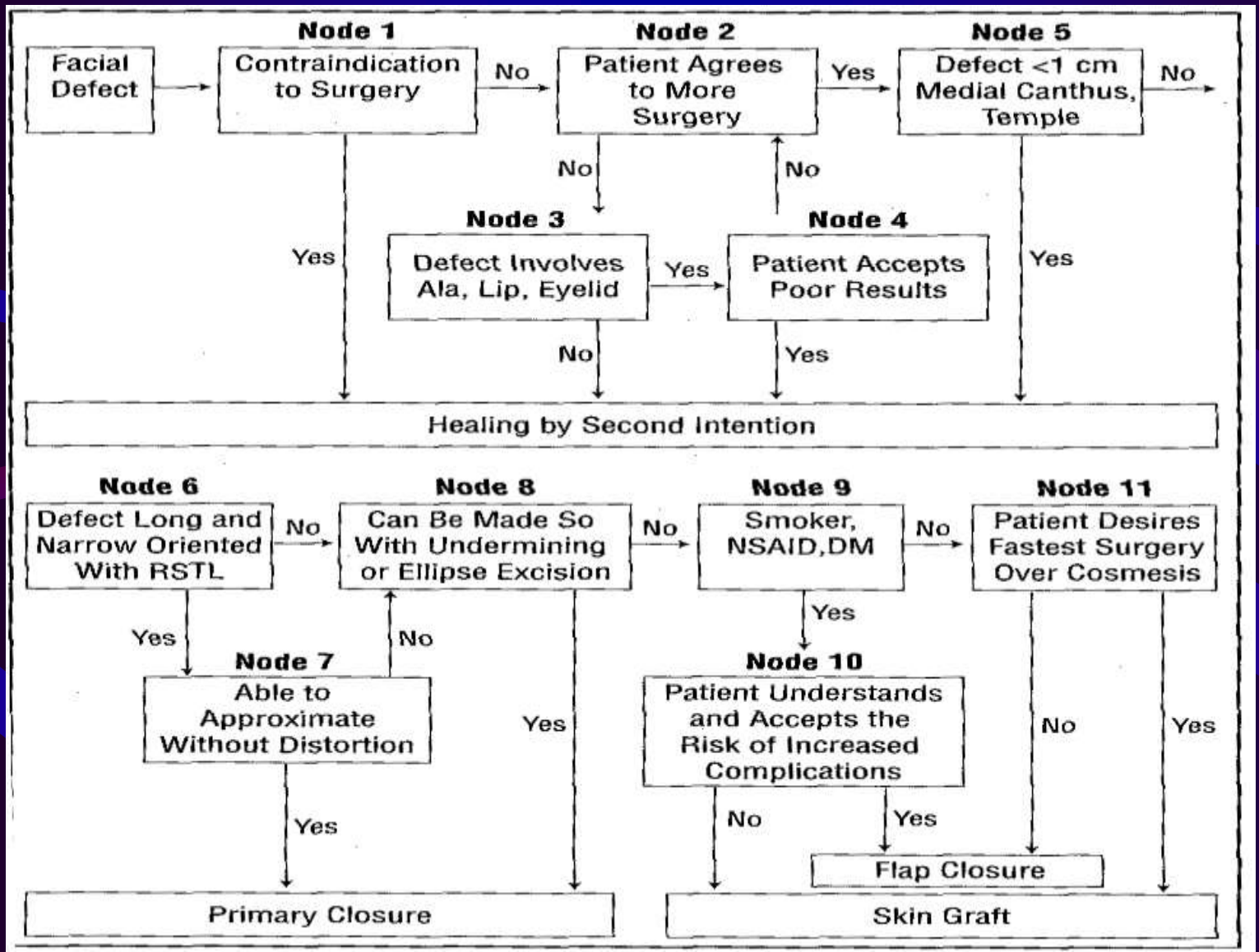
Reconstruction after Mohs - Paradigm



Reconstruction - secondary intention

- Indicated in defect < 1cm in medial canthal area
- Also ok result temple, forehead, periauricular
- Relative contraindication nasal ala, eyelid, and lip
- Controversy auricle

Reconstruction after Mohs - Paradigm



Reconstruction - primary closure

- Defect can be made long and narrow 3:1 in RSTL

Reconstruction - primary closure

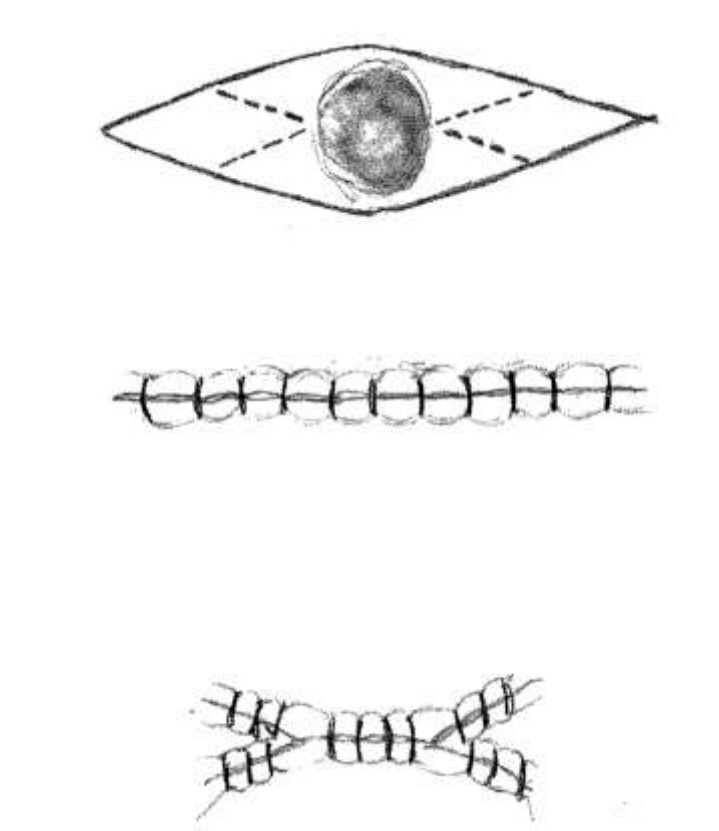
- Younger patients require more undermining
- Undermining usually one width on either side at center, total of one at ends
- Can’t distort nondistortable structures

Table 1. Nondistortable Structures and Facial Anatomic Units That Often Provide Skin for Reconstruction

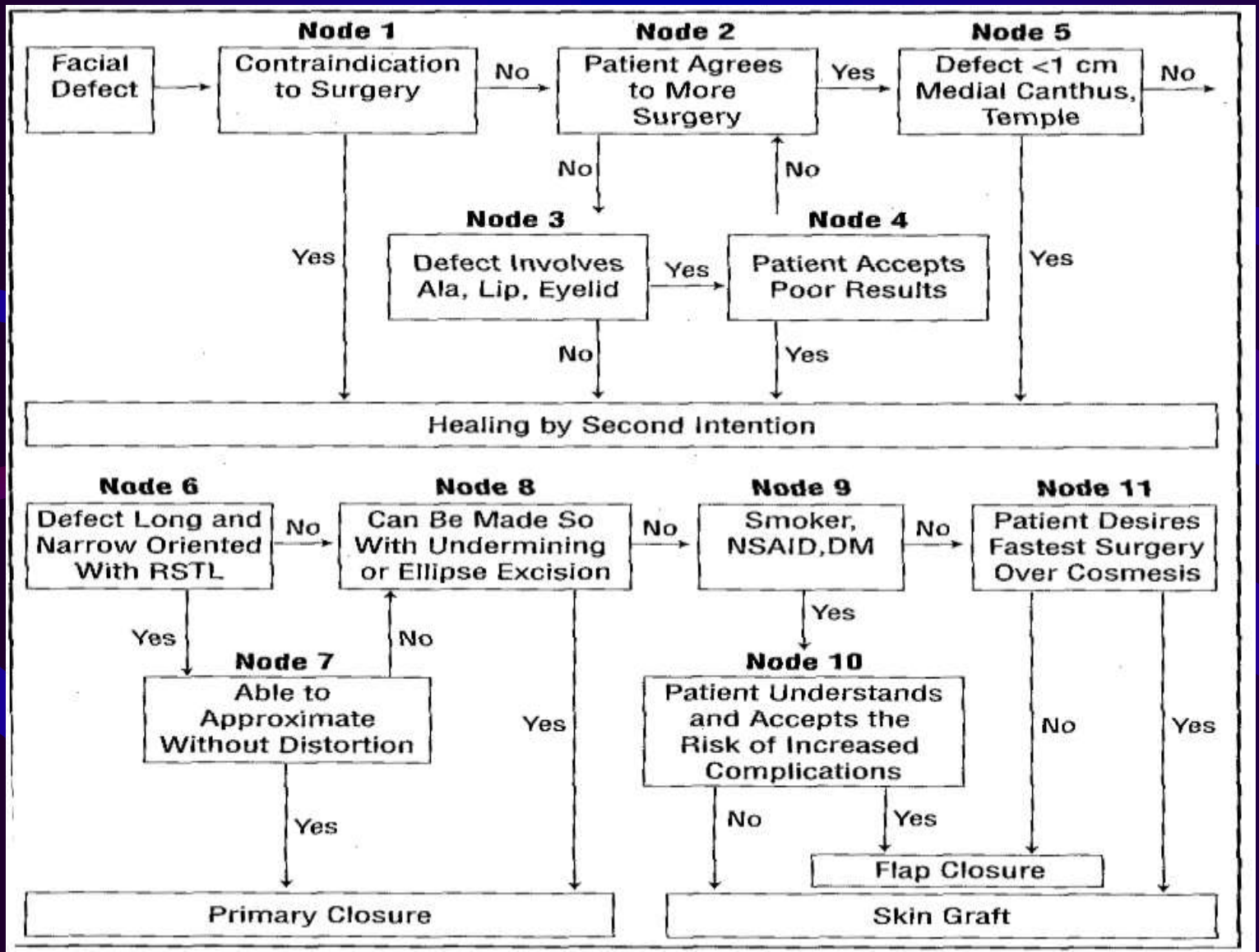
Nondistortable Structures	Good Lender Units
Nasal tip	Cheek
Nasal alae	Forehead
Central upper lip	Chin
Vermilion	Submentum
Oral and ocular commissures	Neck
Eyelids and canthi	
Eyebrows	
Hairline	
Earlobe	

Reconstruction - primary closure

- M-plasty



Reconstruction after Mohs - Paradigm



Reconstruction after Mohs - skin grafting

- Use full thickness, epidermis and dermis on face
- Survival depends upon adequate nutrition and removal of waste
- Close contact without separation, immobile
- Adherence by fibrin exudate, plasma provides nutrition and transports waste
- Outgrowth of capillary buds by 3rd or 4th day

Reconstruction after Mohs - skin grafting

- Fibrin infiltrated by fibroblasts, fibrous attachment 4th or 5th day
- Good capillary budding from muscle, periosteum, perichondrium, not bare bone, cartilage or tendon
- Common donor sites - preauricular, postauricular, melolabial fold, supraclavicular area, and for eyelid defects, upper eyelid skin

Reconstruction after Mohs - facial flaps

- Facial esthetic units

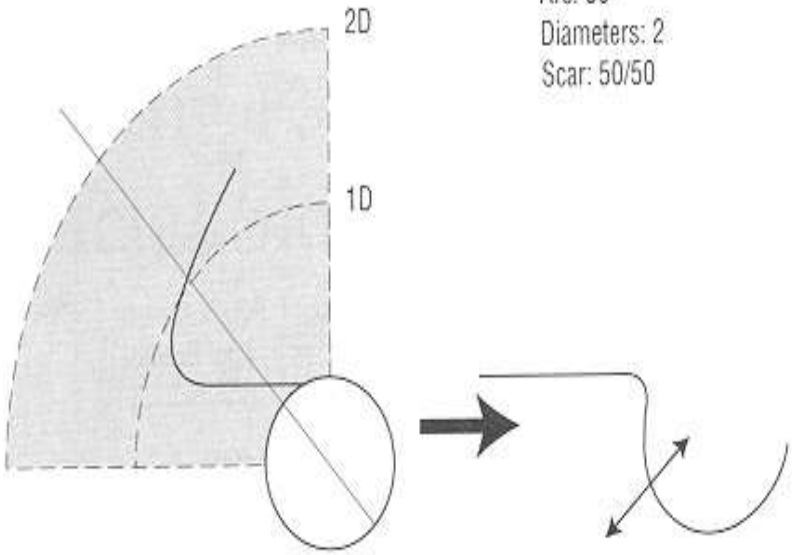
Reconstruction after Mohs - facial flaps

- Cannot distort non-distortable structures
- Attempt to place as much of flap incision in RSTL
- Vector of tension away from important structures

A

Note

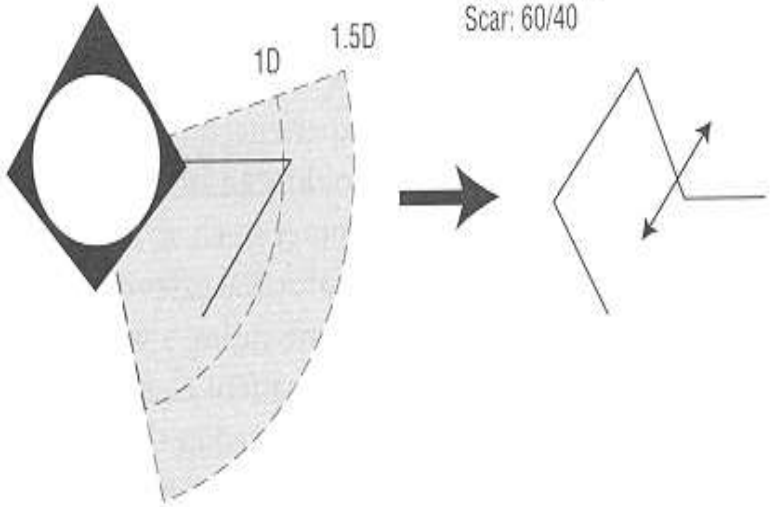
Shape: Circle
Arc: 90°
Diameters: 2
Scar: 50/50



B

Rhomboid

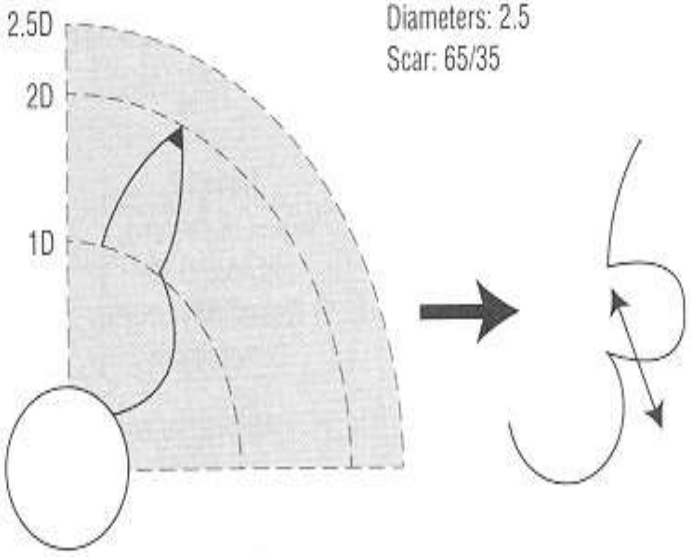
Shape: 3 Rhomboids
Arc: 90°
Diameters: 1.5
Scar: 60/40



C

Bilobed

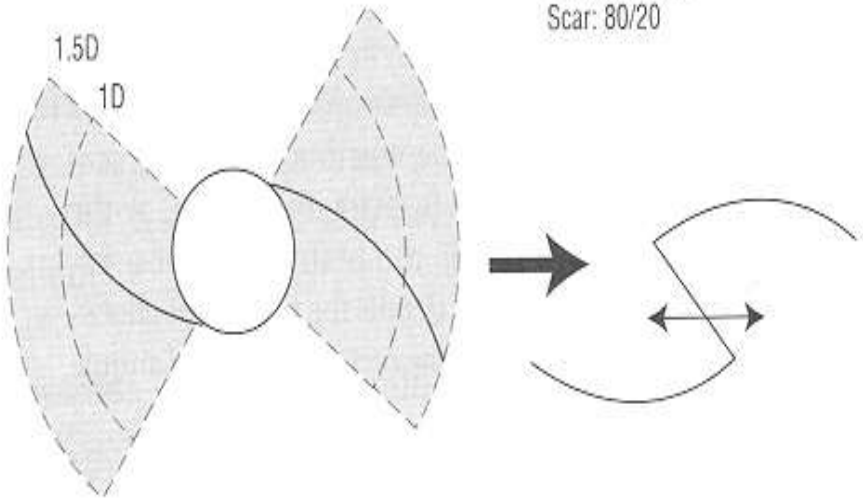
Shape: Circle
Arc: 90°
Diameters: 2.5
Scar: 65/35



D

O-to-Z

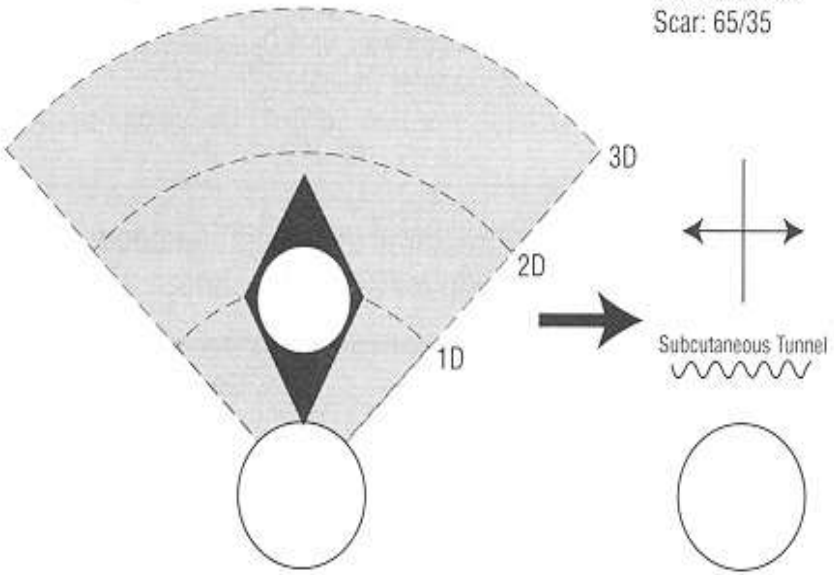
Shape: Circle
Arc: 90°
Diameters: 1.5
Scar: 80/20



E

Subcutaneously Pedicled

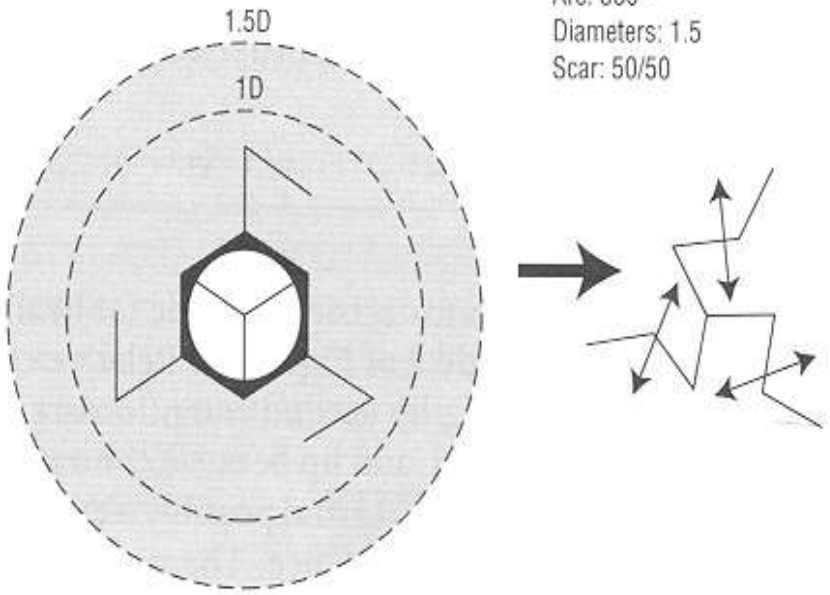
Shape: Ellipse
Arc: 90°
Diameters: 2-3
Scar: 65/35



F

Triple Rhomboid

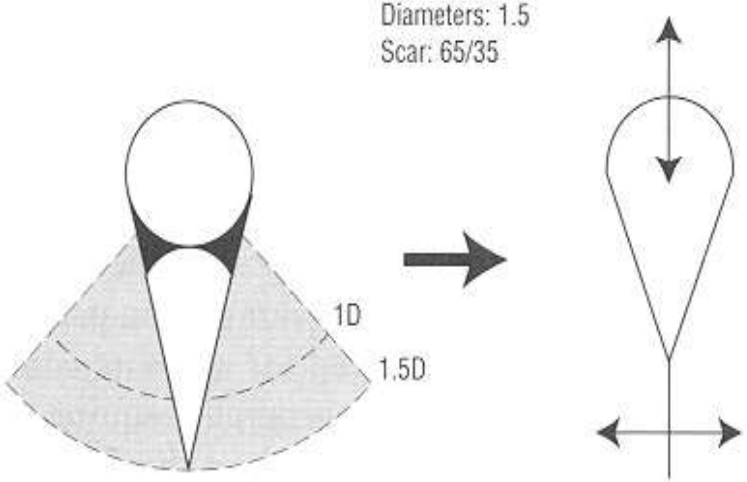
Shape: 3 Rhomboids
Arc: 360°
Diameters: 1.5
Scar: 50/50



G

V-to-Y

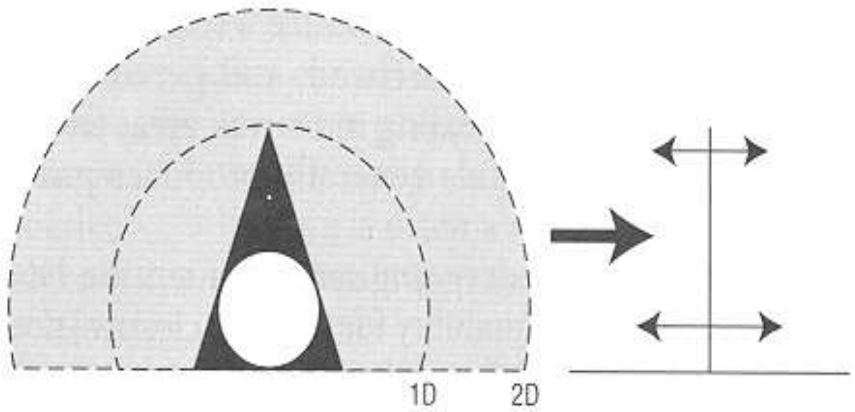
Shape: Bread Slice
Arc: 90°
Diameters: 1.5
Scar: 65/35



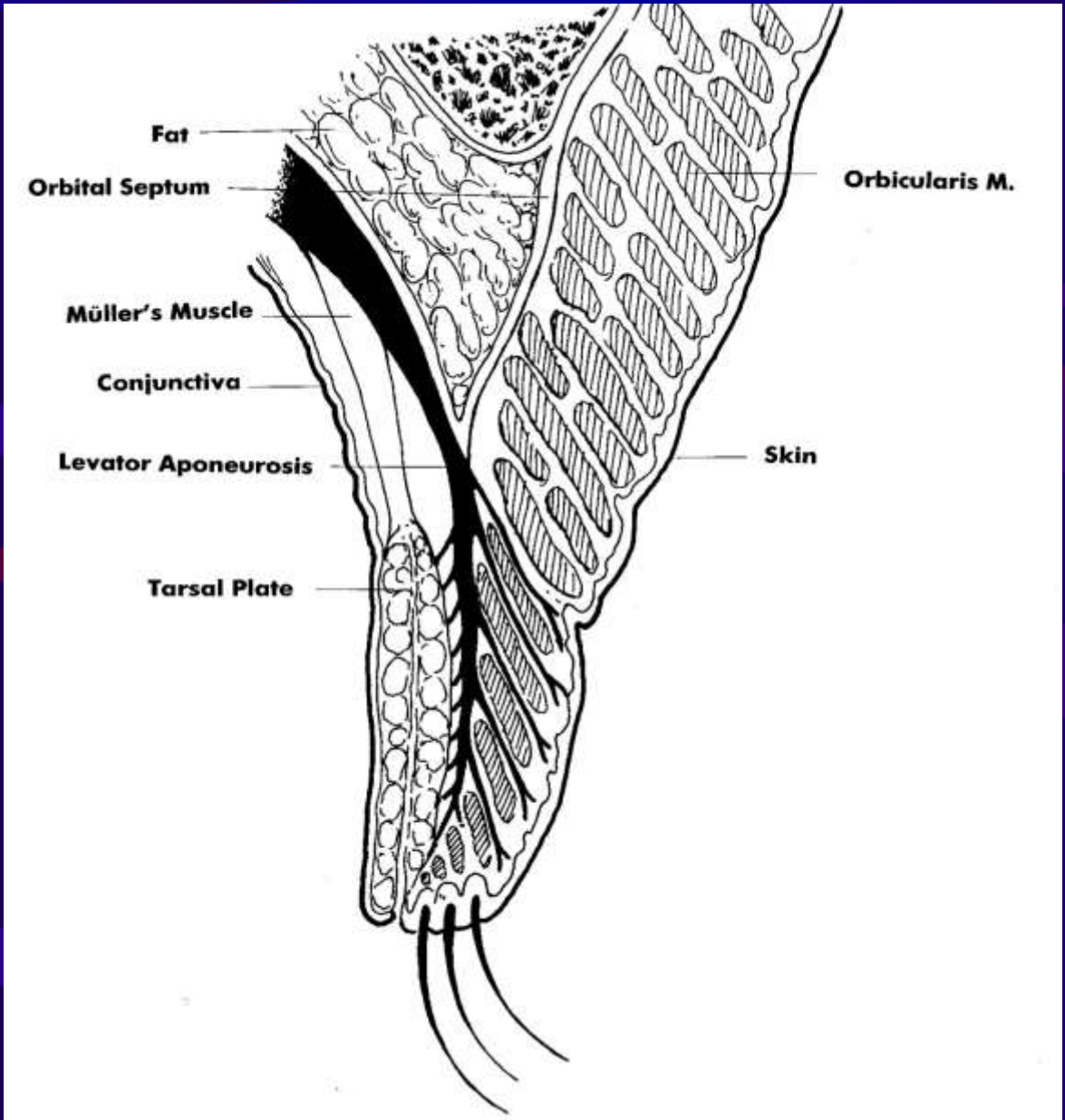
H

A-to-T

Shape: Isosceles Triangle
Arc: 180°
Diameters: 2
Scar: 60/40



Reconstruction - eyelids, anatomy



Reconstruction - eyelids consideration

- smooth mucous membrane internal lining
- skeletal support equivalent to the tarsus
- stable margin, keep eyelashes from cornea
- proper fixation of medial and lateral canthal attachments
- adequate muscle for closure
- supple, thin skin to allow eyelid excursion
- adequate levator action to lift upper lid above visual axis

Reconstruction - eyelids

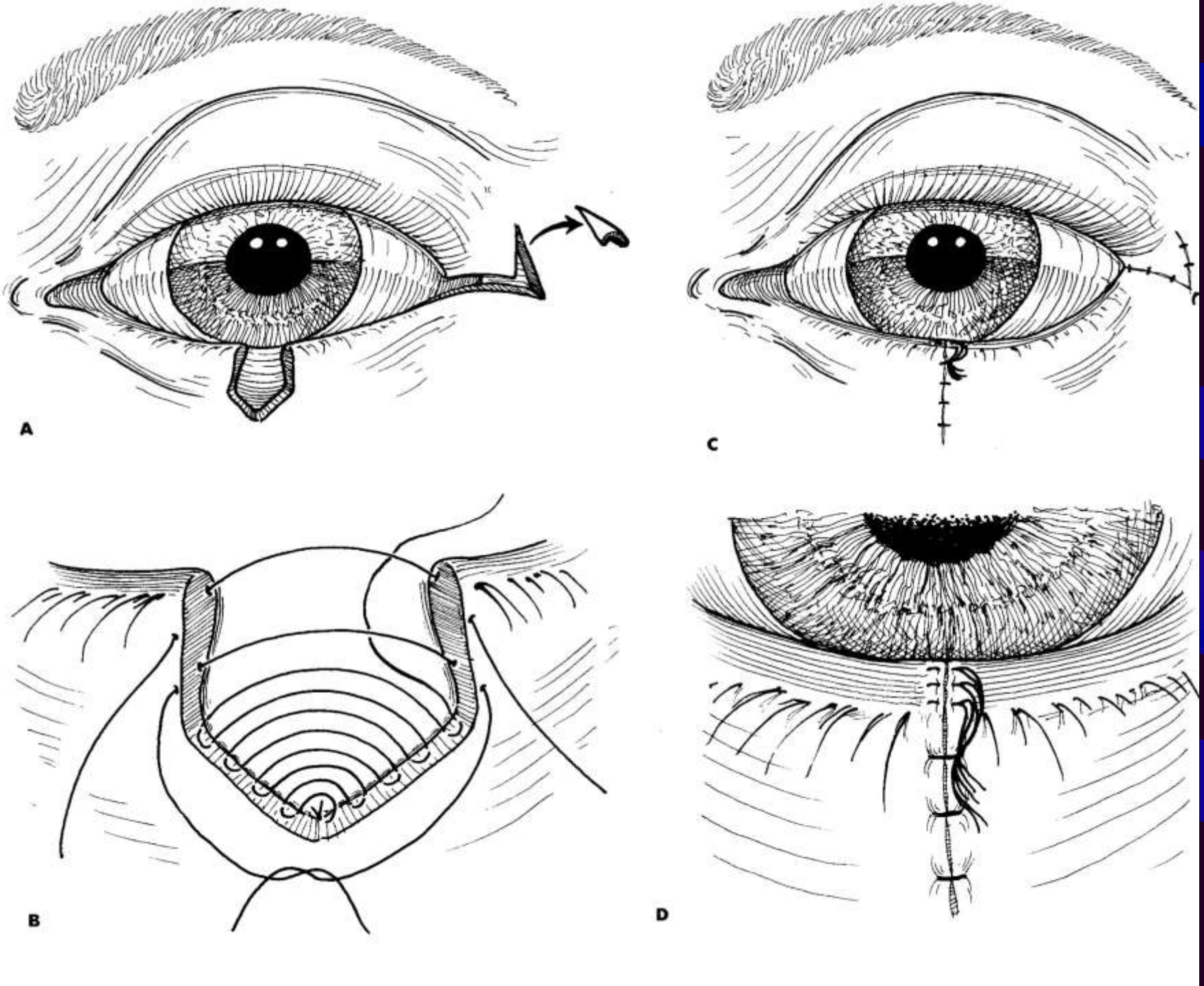
- deep component loss require complex repair
- skin and sub-Q tissue primary closure, full thickness skin graft, or rotation flaps
- Upper eyelid defect too large for primary closure FTSG contralateral eyelid
- preauricular or postauricular skin next best option
- lower eyelid sensitive to contraction and ectropion

Reconstruction - eyelids

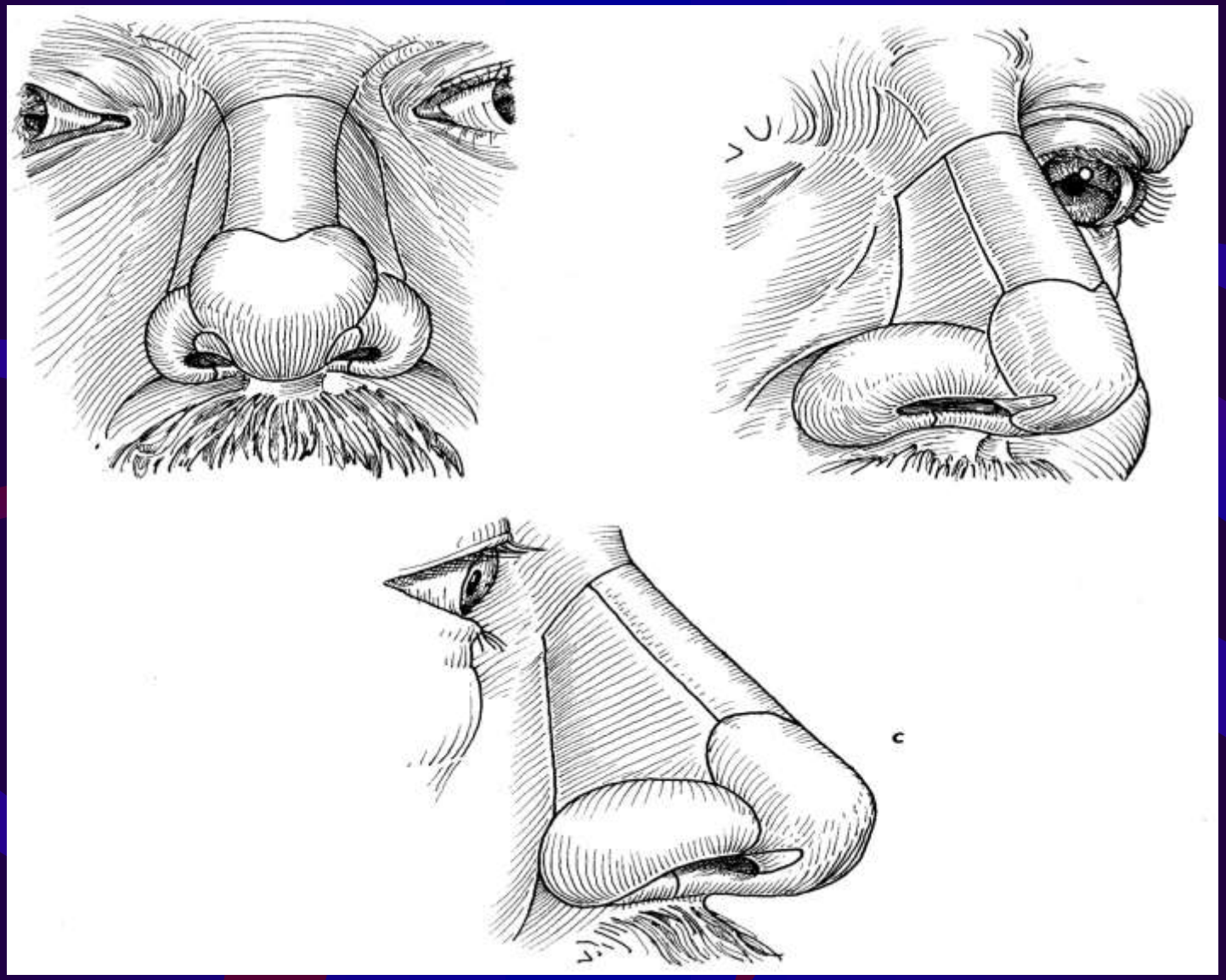
- skin grafting for small 1 cm defect
- larger defects repaired with advancement rotation flaps from lateral cheek

Eyelids full thickness - direct repair, cantholysis

- upper and lower up to 50%
- borders perpendicular to eyelid margin
- made into pentagon by excision of tissue below tarsus
- skin hooks to pull edges together in no tension repair
- tension then lateral canthotomy and cantholysis


A
B
C
D

Reconstruction - nose



Nose - evaluation

- what tissue layers are missing, what subunits are missing
- if greater that 50% of subunit involved better to excise whole subunit
- must replace missing tissue with like tissue
- septal and conchal cartilage
- septal or bipartite intranasal lining flaps

Reconstruction - nasal skin

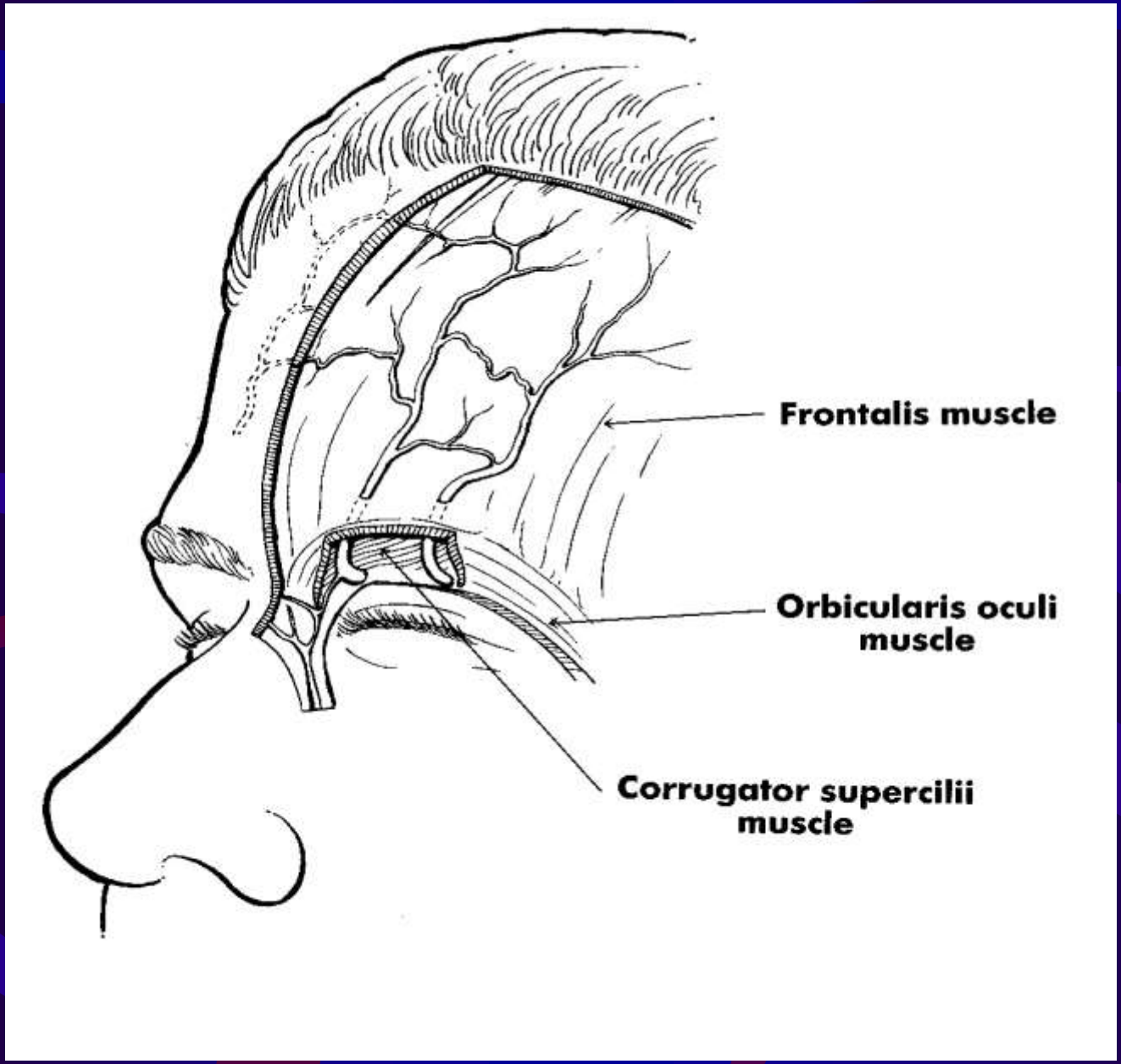
- convex subunits - dorsum, tip, alae, columella reconstruct well with flaps
- concave subunits - soft triangle and nasal sidewalls reconstruct well with skin grafts
- thin skinned regions; dorsum, sidewalls, collumella, lower half of infratip lobule
- repair with transposition flaps for defects < 1.5 cm or preauricular skin grafts

Reconstruction - nasal skin

- thick skinned regions; alae, upper nasal tip
- repair with bilobed flap for lesion < 1.5 cm
- larger defects require PMFF or nasolabial flap for alar subunit

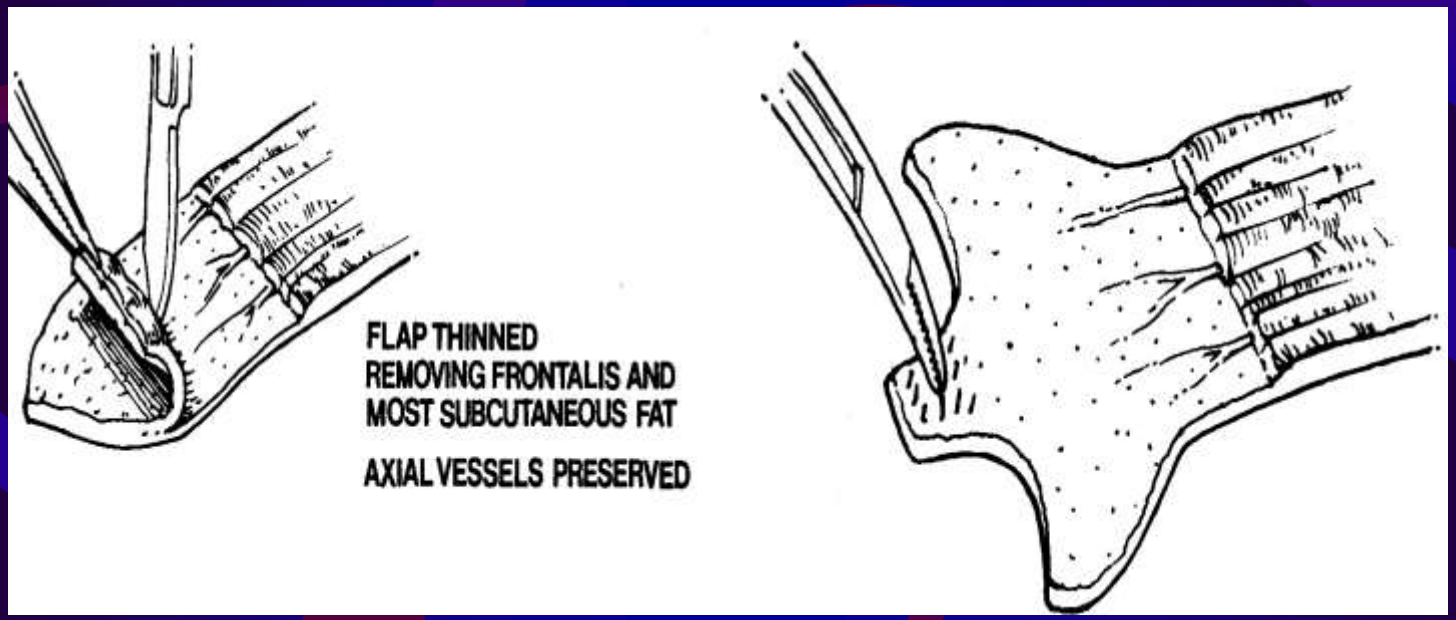
Nose - PMFF

- axial flap based on supratrochlear artery primarily, dorsal nasal arteries and supraorbital artery
- supratrochlear deep to obicularis, over corrugator, piercing temporalis to run in superficial subcutaneous tissues external to the frontalis muscle


Frontalis muscle
Orbicularis oculi muscle
Corrugator supercilii muscle

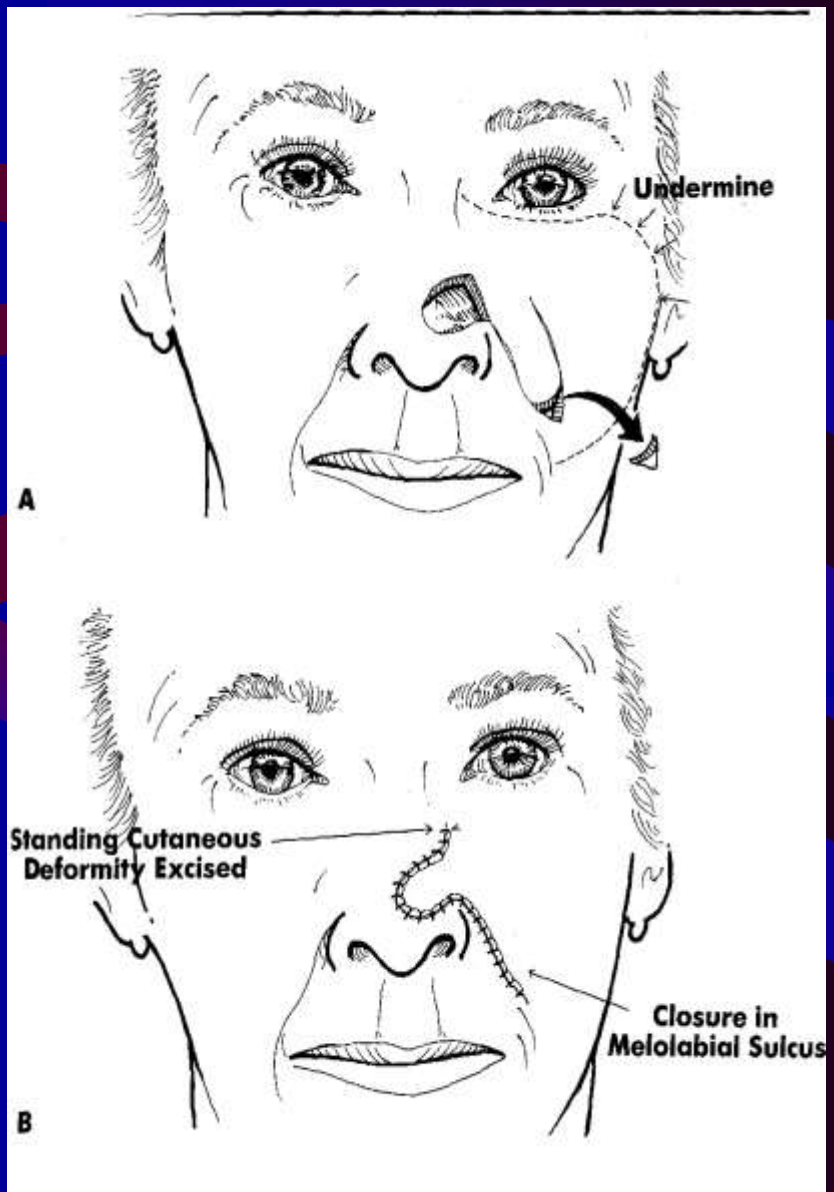
Nose - PMFF

- may thin distal 1-2 cm to near dermis because of location of artery
- pedicle may be as narrow as 1.2 cm to improve arc of rotation



Nose - superior melolabial flap

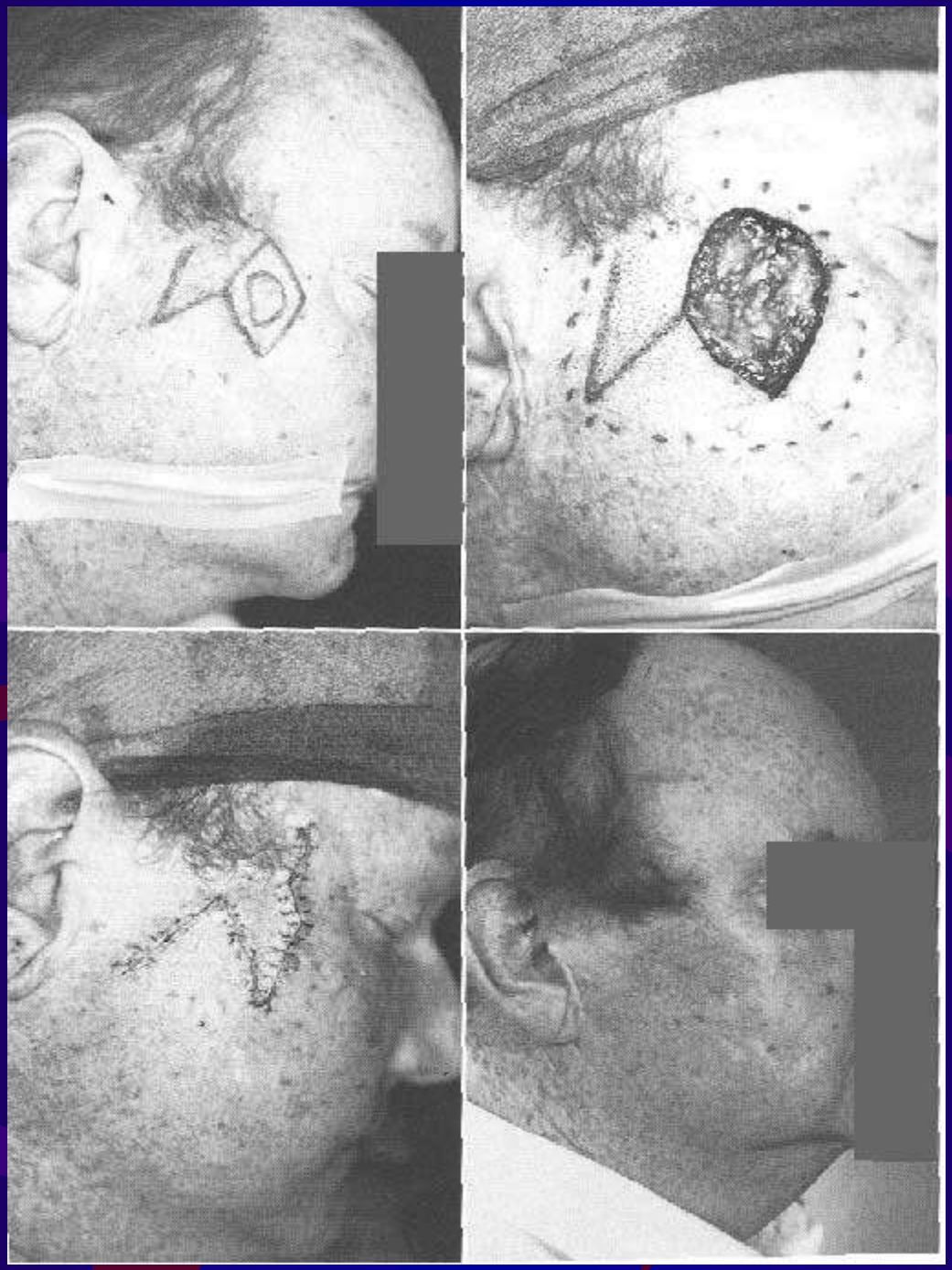
- axial flap from perforators of levator labii superioris
- medial incision in nasolabial fold lateral incision to level of inferior wound



Reconstruction - cheek

- reconstruction aided by laxity of skin and relative abundance
- small to moderate defects closed primarily
- anvancement, transposition, rotation flaps
- caution given to level of facial nerve

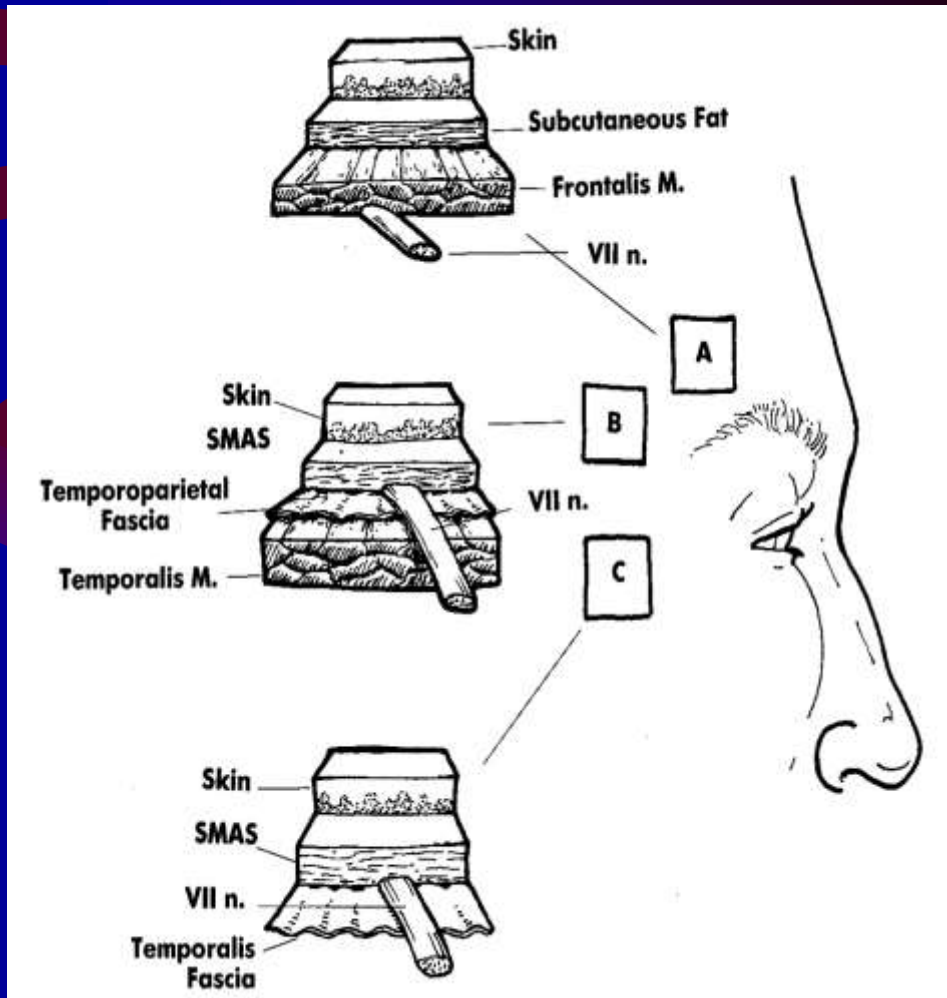
Reconstruction - cheek



Reconstruction - cheek

Reconstruction - forehead

- maintain motor and if possible sensory function



Reconstruction - forehead

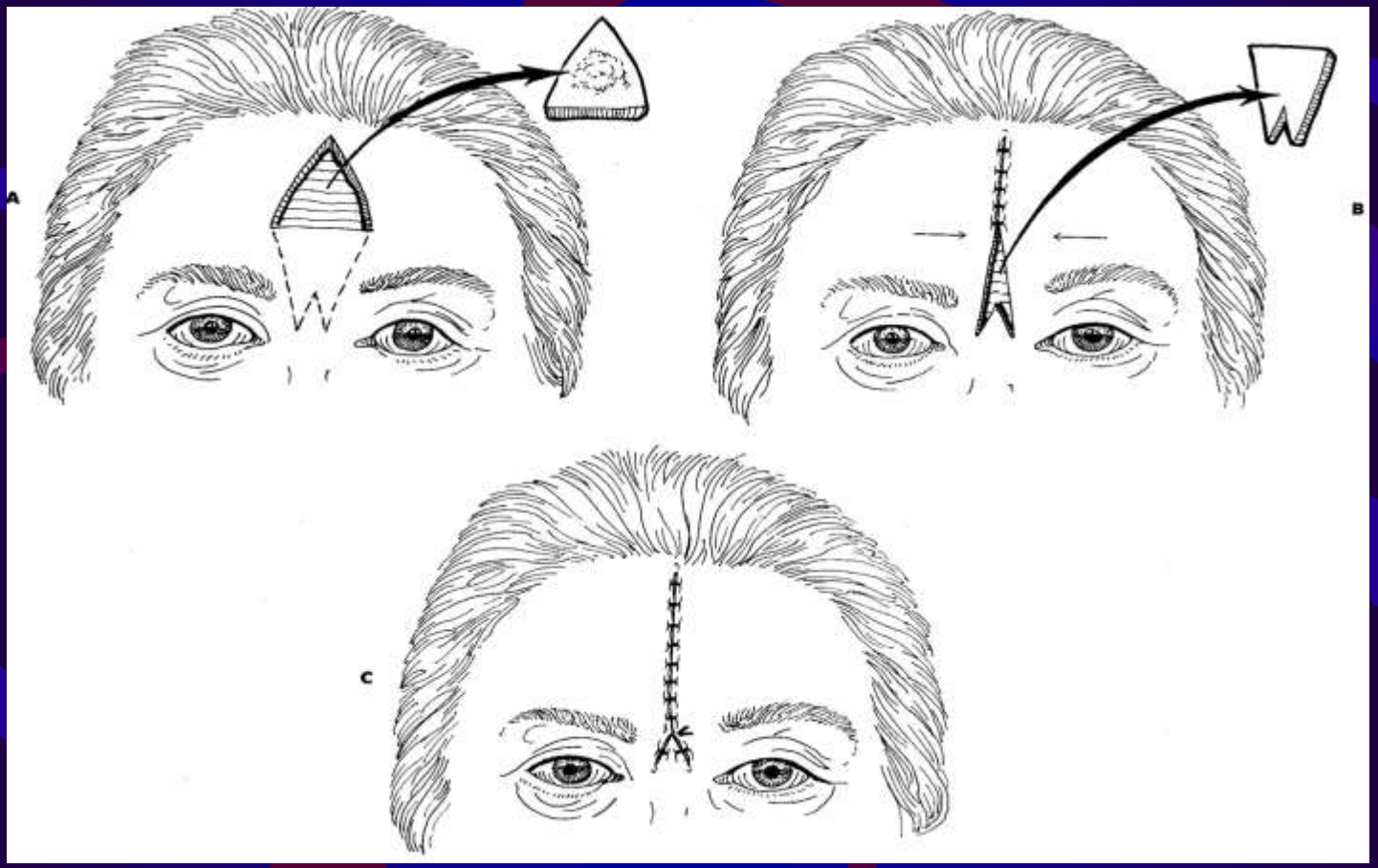
- Sensory function
  - supraorbital and supratrochlear nerve run with vessels in sub-Q tissue to parietal scalp
- maitenance of brow symmetry
- maintenance of natural-appearing temporal and frontal hairlines
- hiding of scars when possible (into hairlines or eyebrows)
- creation of transverse instead of verticle scars whenever possible (except in midline forehead), avoidance of diagonal scars

Reconstruction - forehead

- primary closure

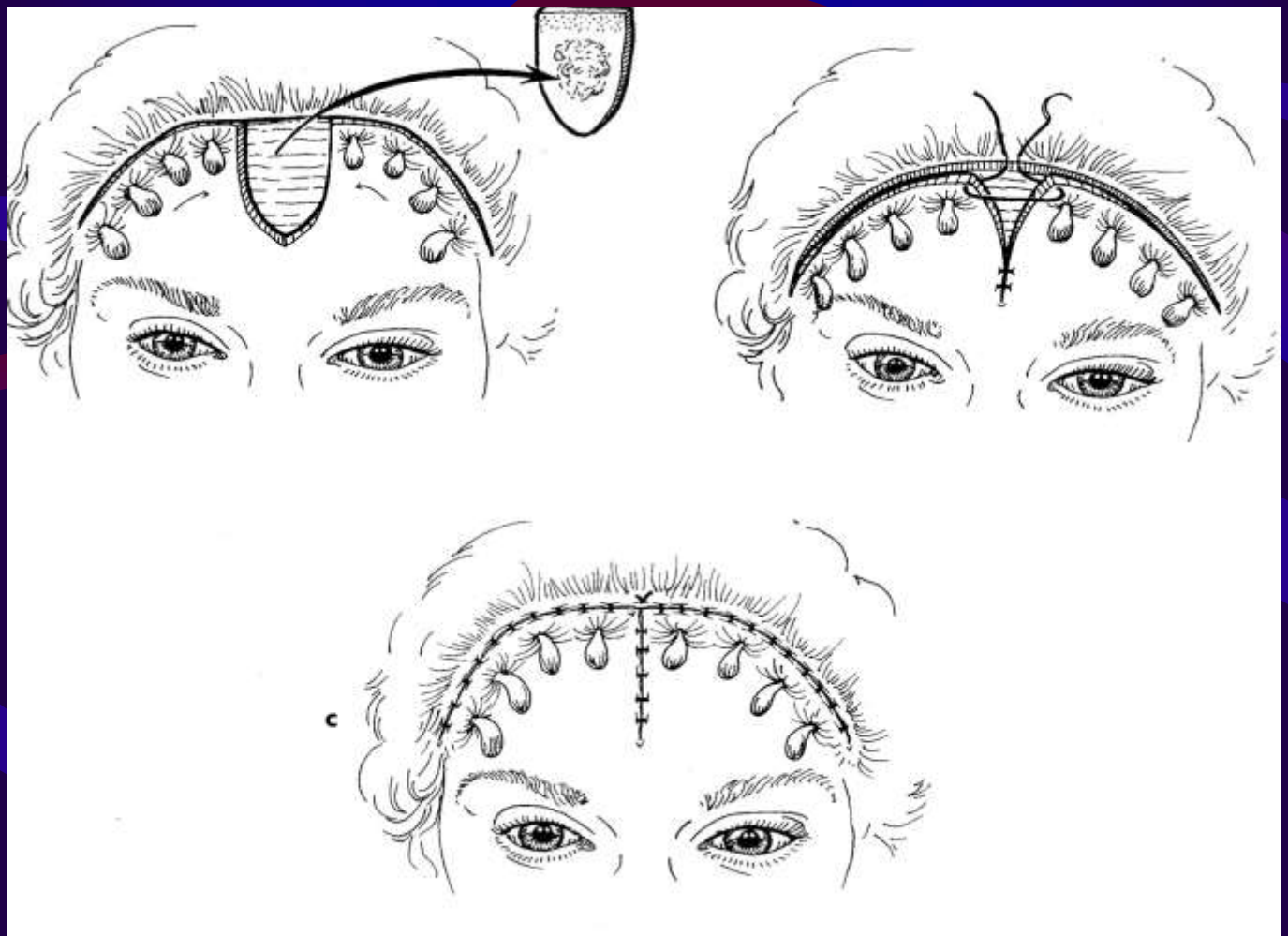
Reconstruction - forehead

- primary closure



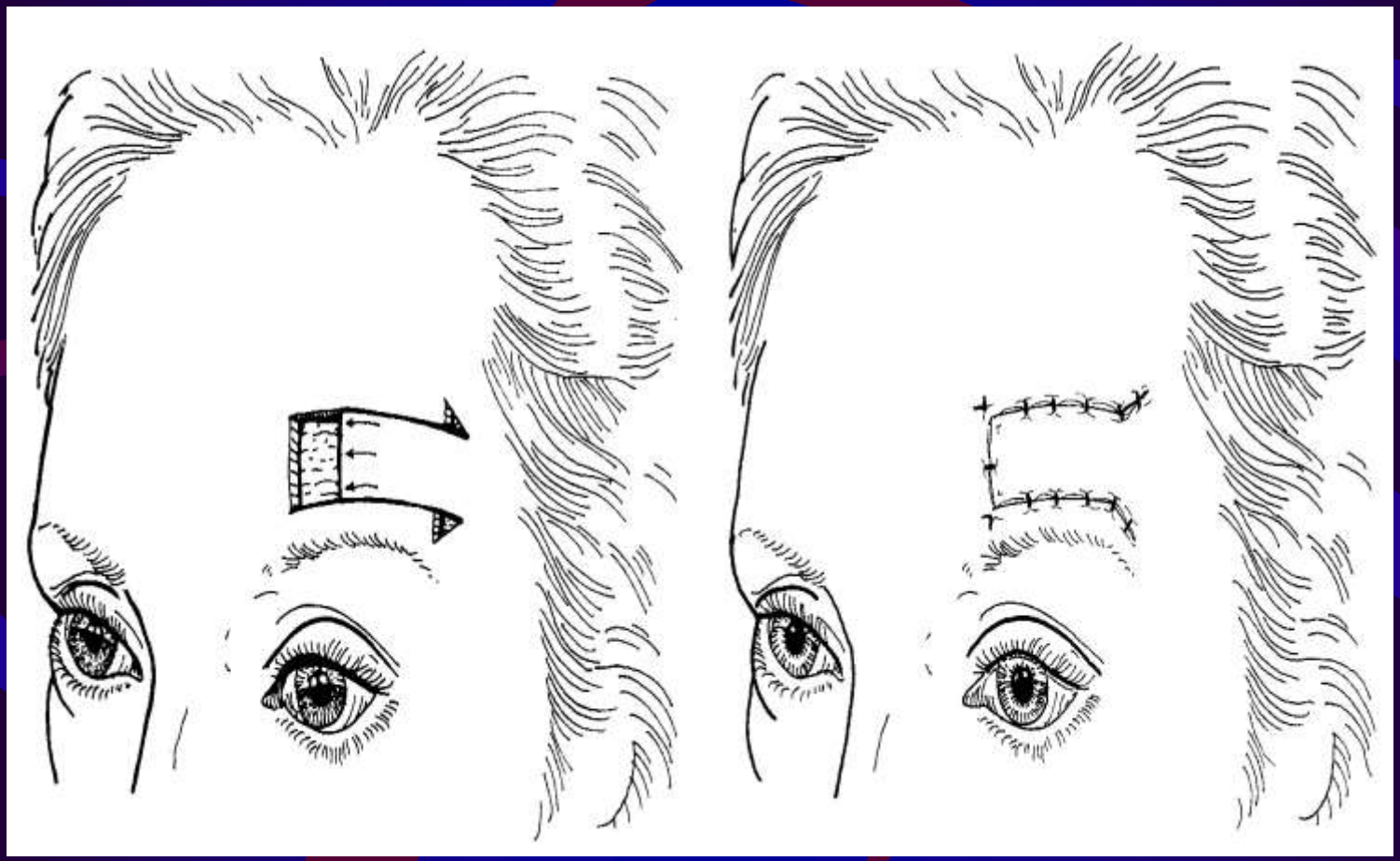
Reconstruction - forehead

- local flaps, A-T, advancement flaps



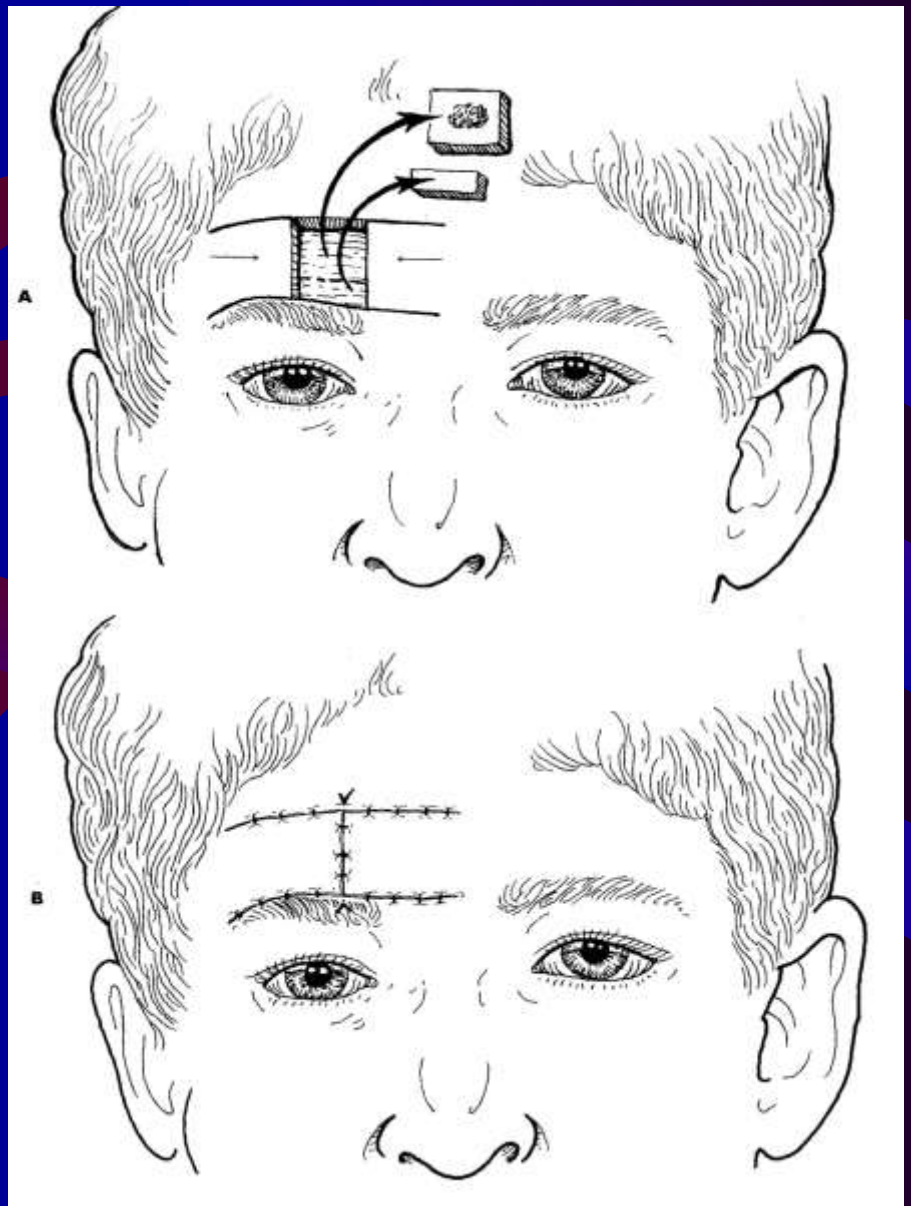
Reconstruction - forehead

- local flaps, A-T, advancement flaps

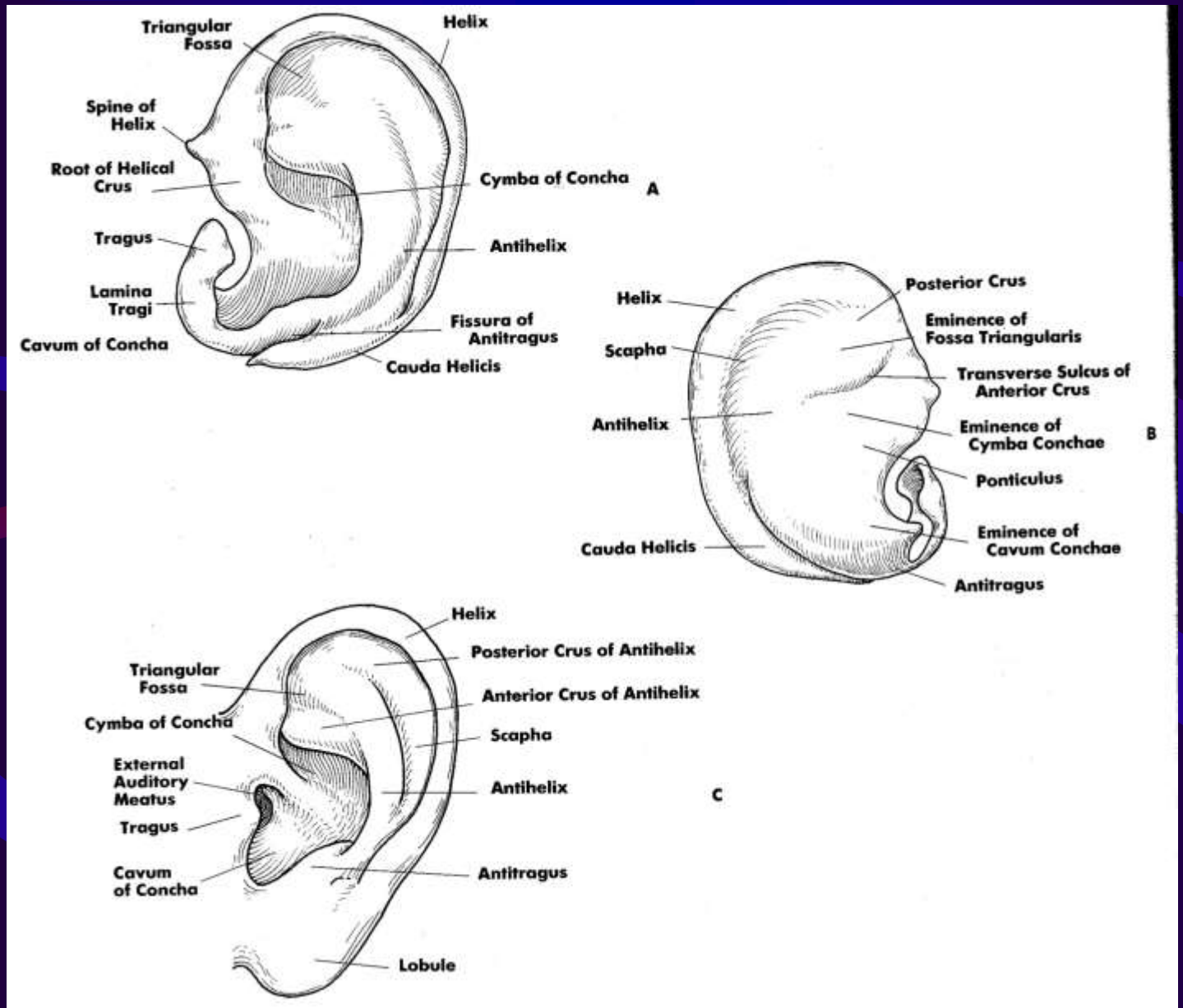


Reconstruction - forehead

- local flaps, A-T, advancement flaps



Reconstruction - auricle anatomy



Reconstruction - auricle anatomy

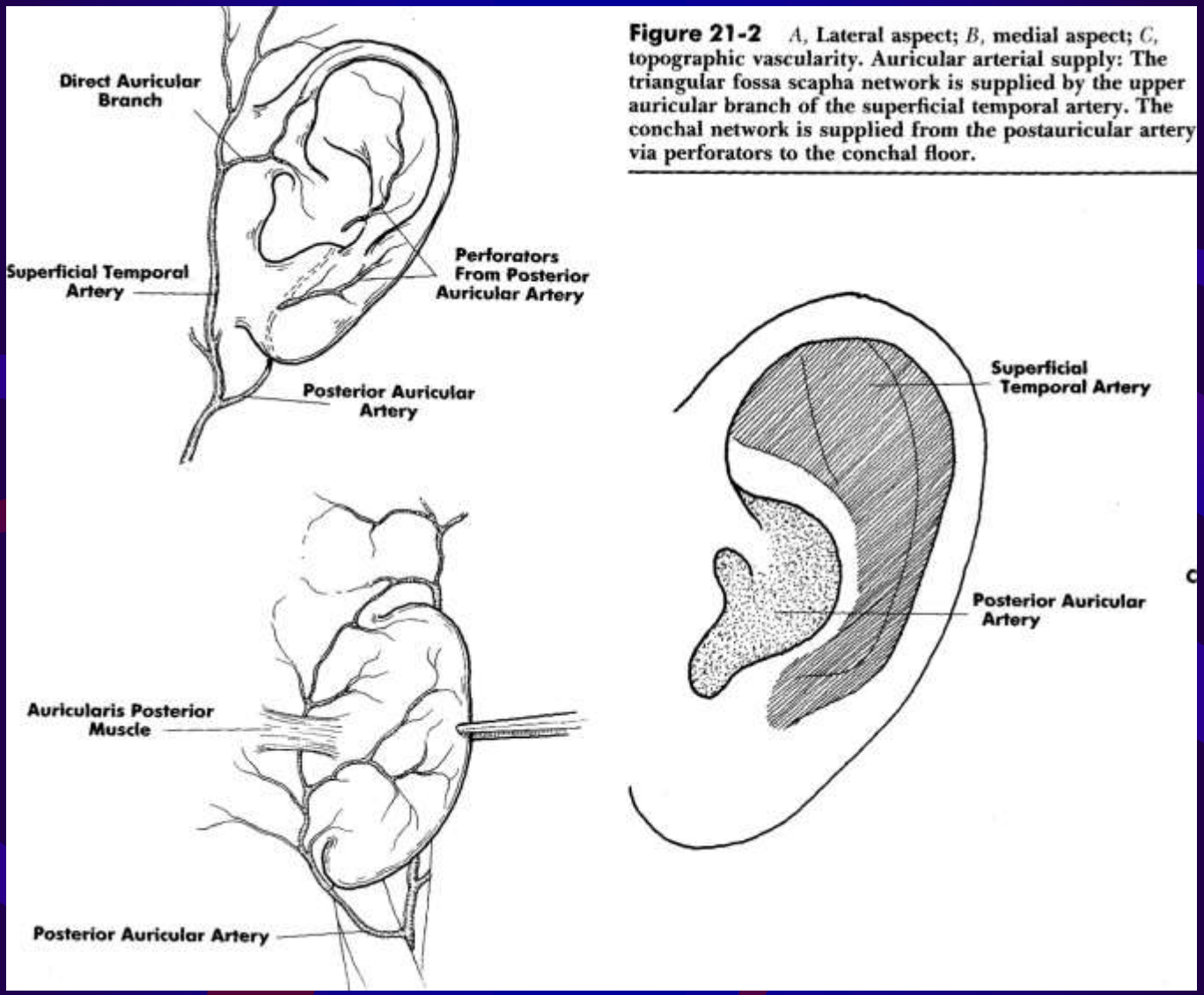


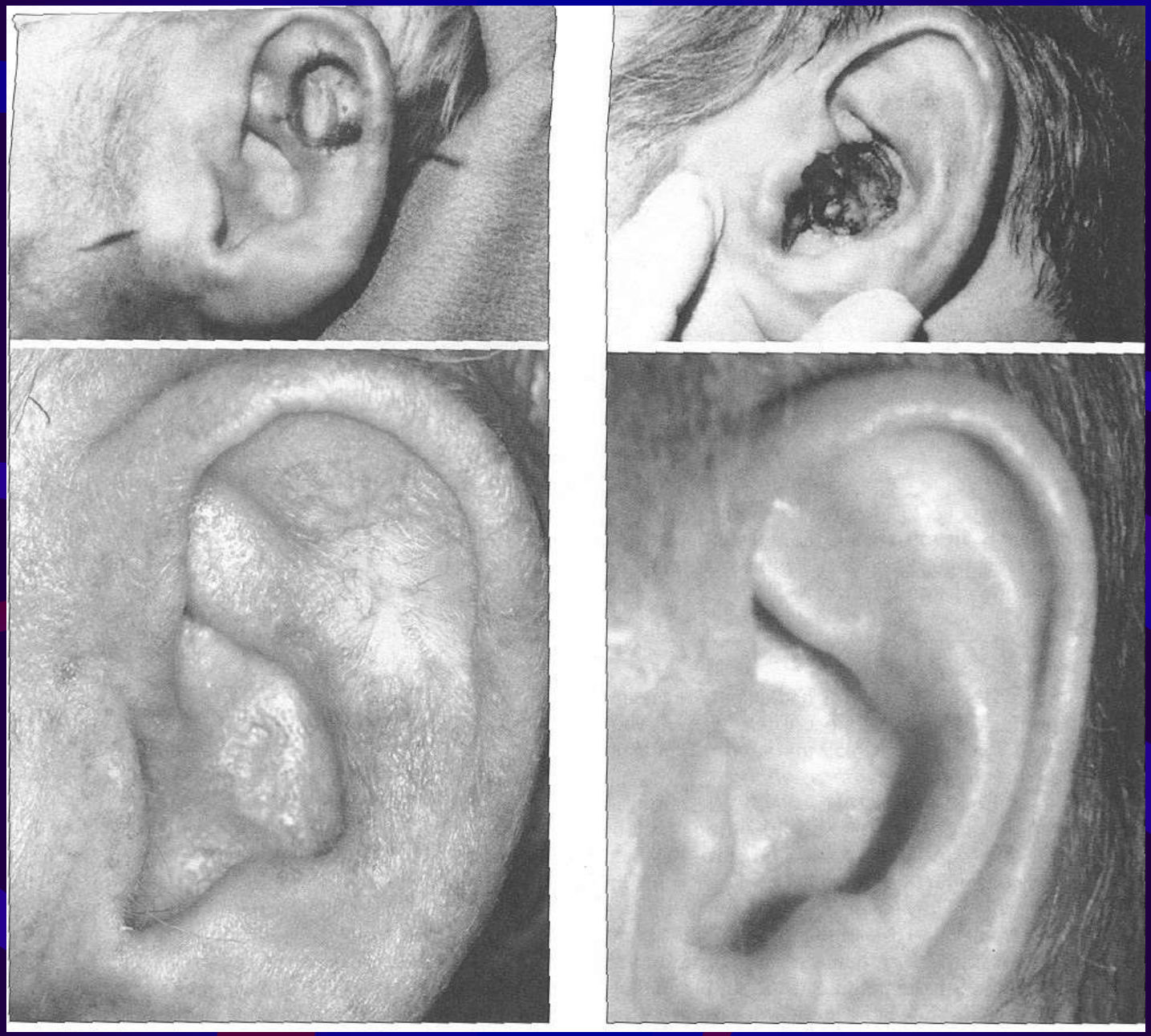
Figure 21-2 *A*, Lateral aspect; *B*, medial aspect; *C*, topographic vascularity. Auricular arterial supply: The triangular fossa scapha network is supplied by the upper auricular branch of the superficial temporal artery. The conchal network is supplied from the postauricular artery via perforators to the conchal floor.

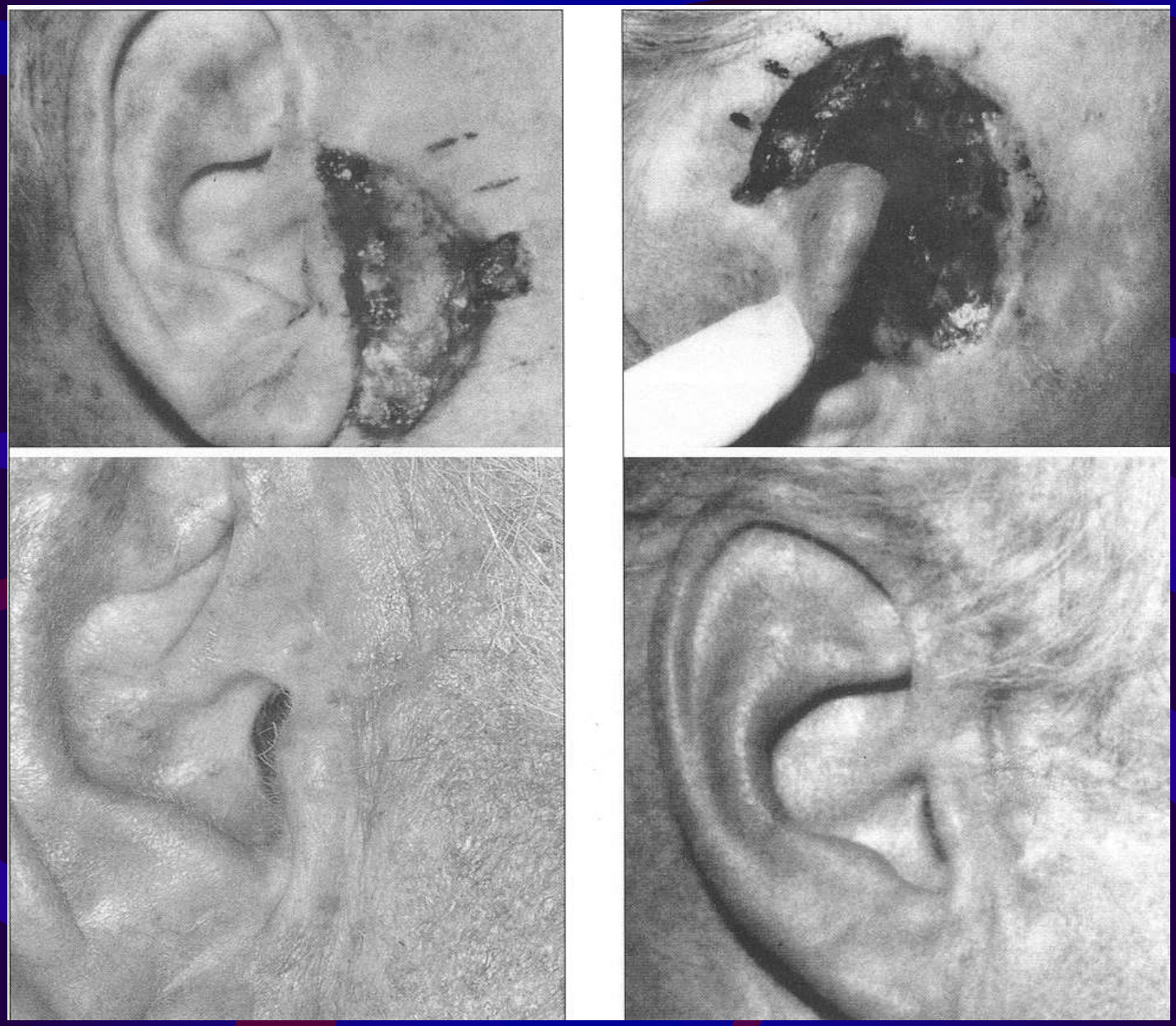
Reconstruction - auricle

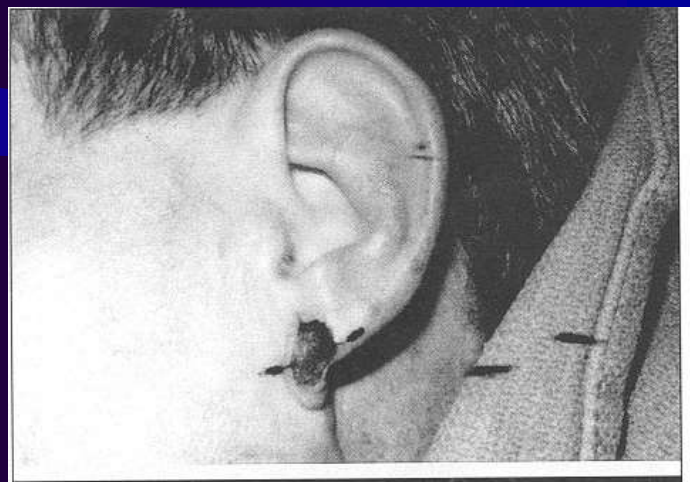
- cutaneous defect vs. cartilage involvement
- heal by secondary intention
- Barry observed 133 patients for results of 2nd intention
- helix cartilage with at least one perichondrium intact
- cutaneous defect with exposed carilage in many

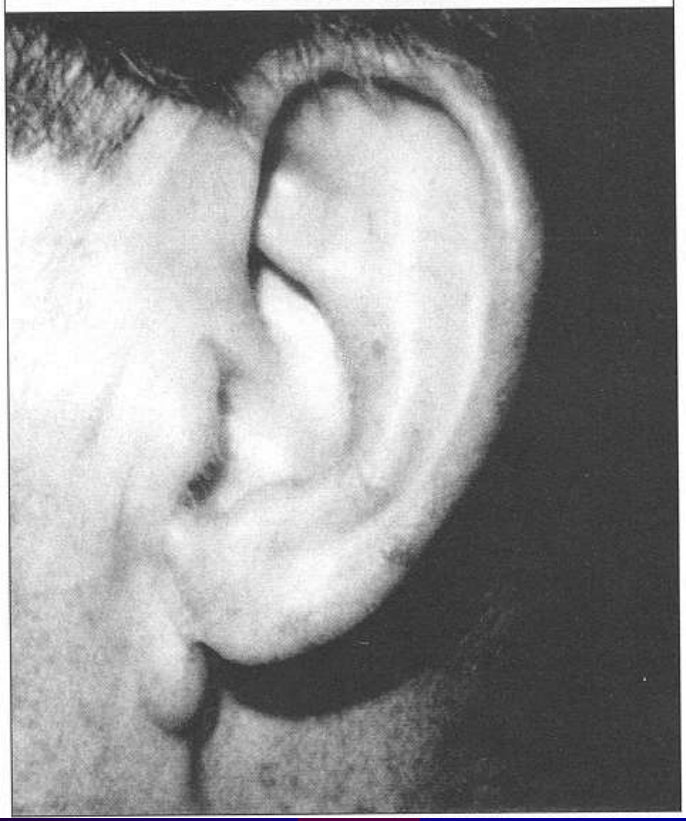
Reconstruction - auricle

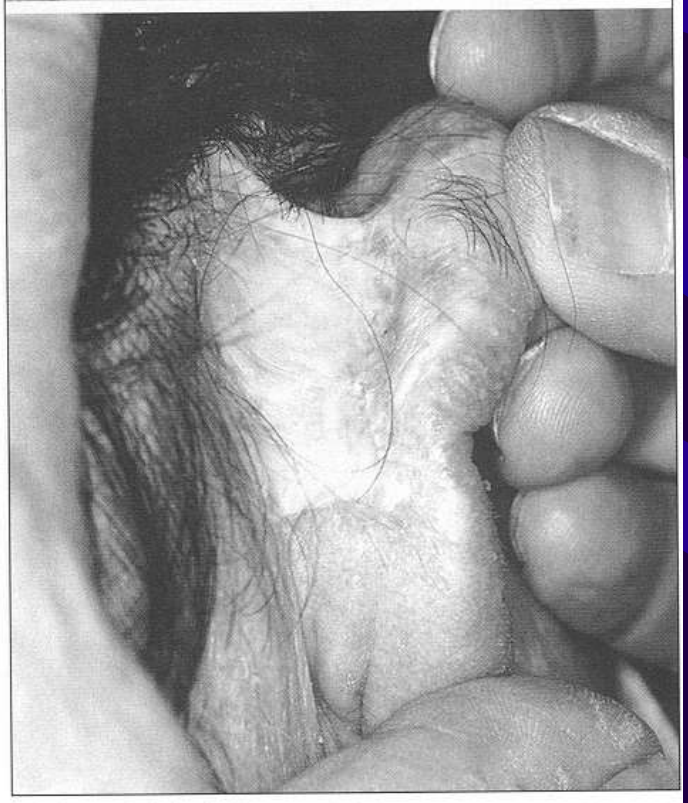
- antihelix 16/18, concha 12/14, tagus/pretragus 15/16
- lobule 2/9

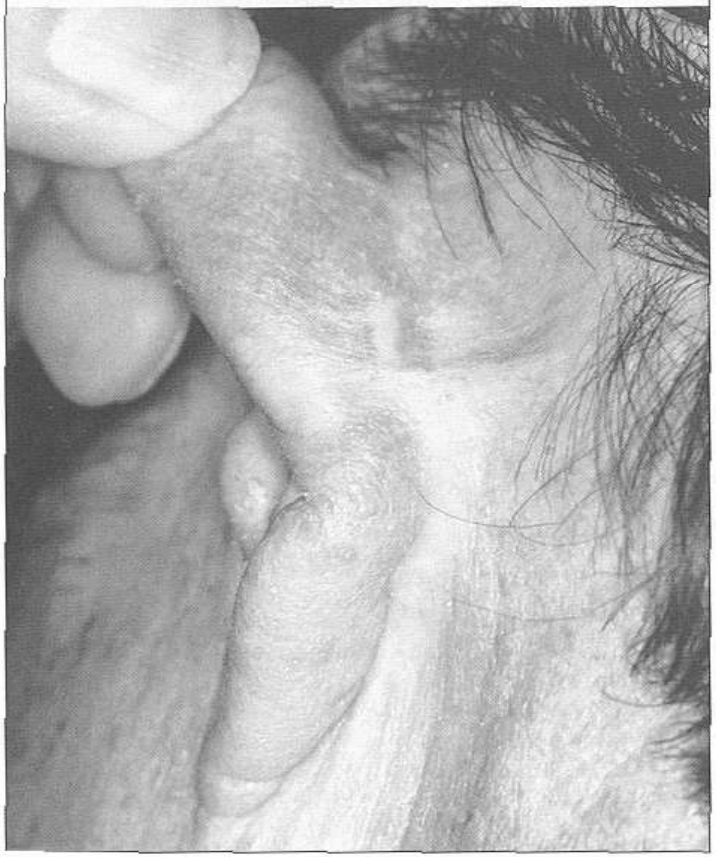


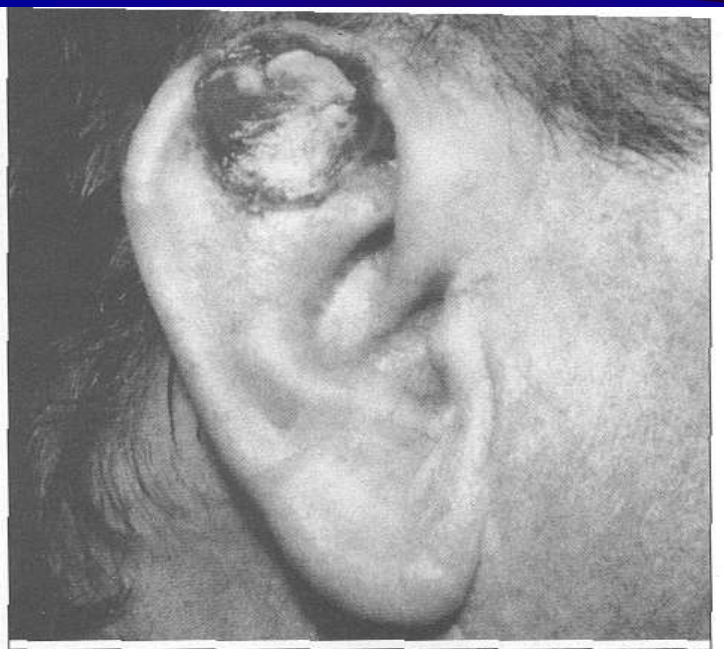


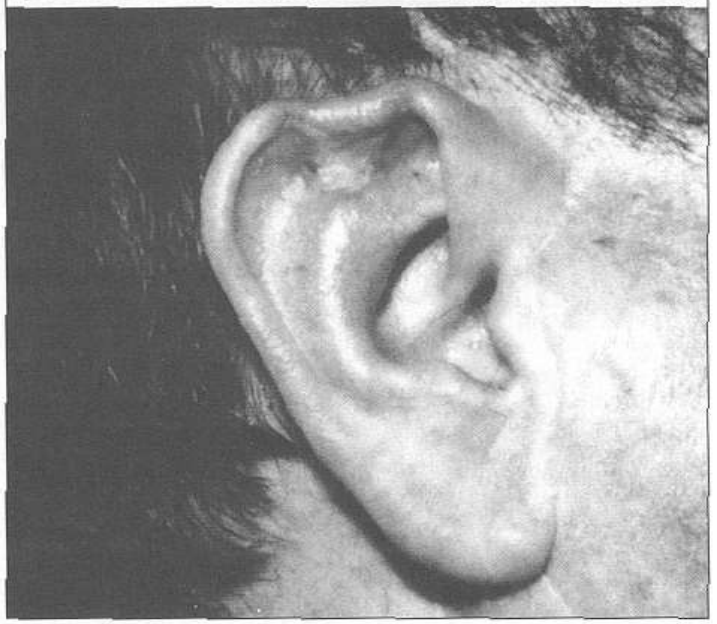












Reconstruction - auricle

- skin grafting, post auricular skin
- primary closure, small helix/antihelix defects < 1.5 cm, shorter ear verticle height
- > 2 cm composite graft opposite ear 1/2 size of defect

Reconstruction - lip anatomy

- skin, muscle, obicularis oris
- vermillion - modified mucosa, anterior limit vermillion line, post innermost contact with closed mouth
- upper lip - base of nose, melolabial sulcus, commisure
- lower lip - mental crease to commisure

Reconstruction - lip anatomy

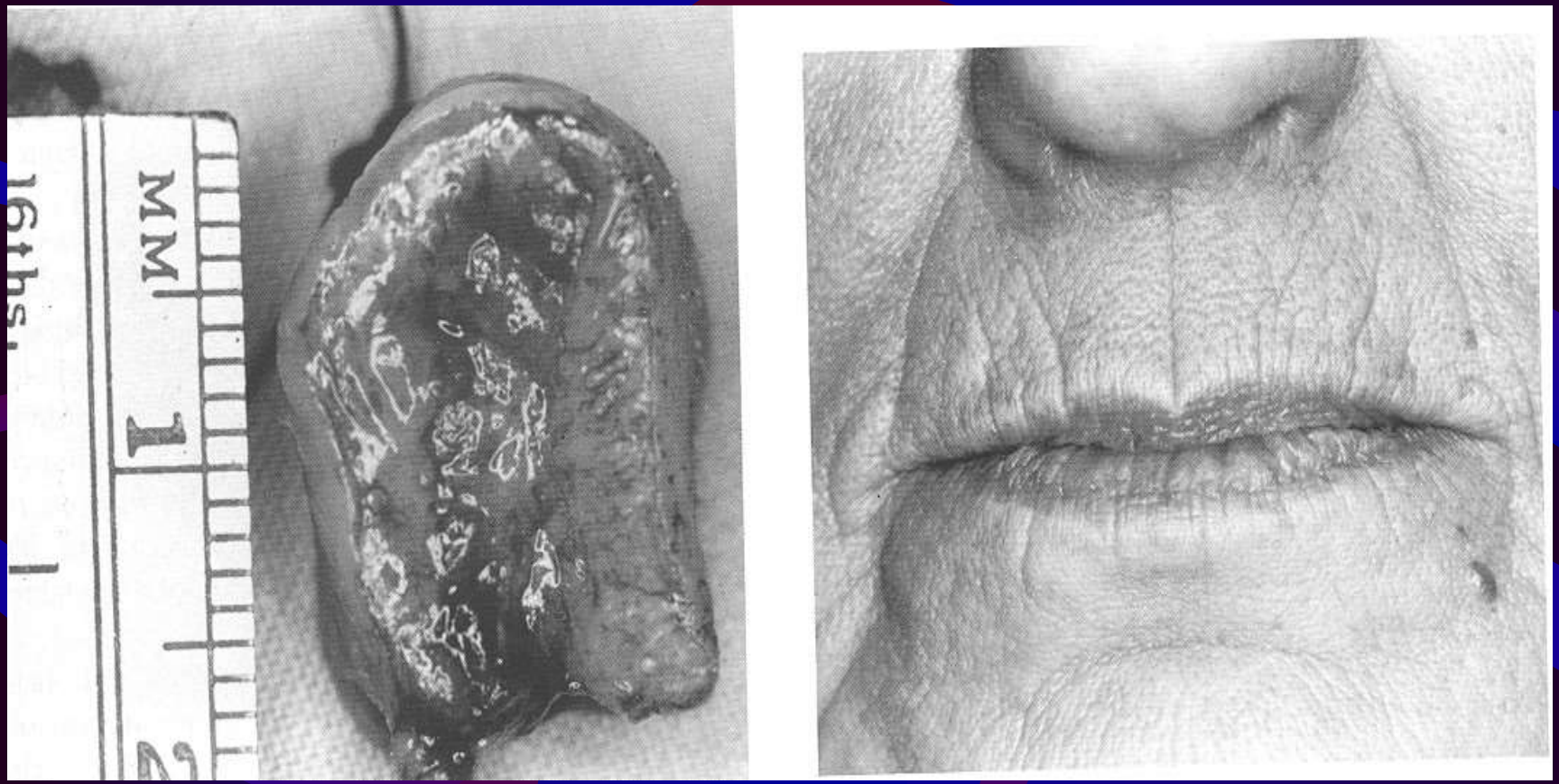


Figure 18-50 Algorithm for reconstruction of lower lip defects.

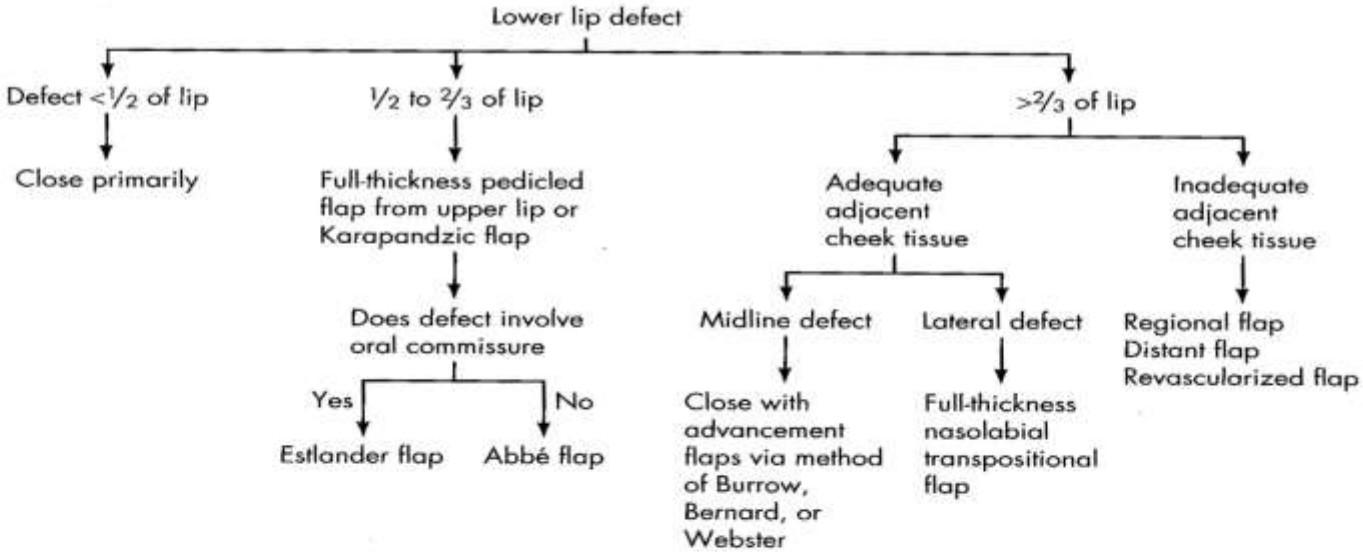
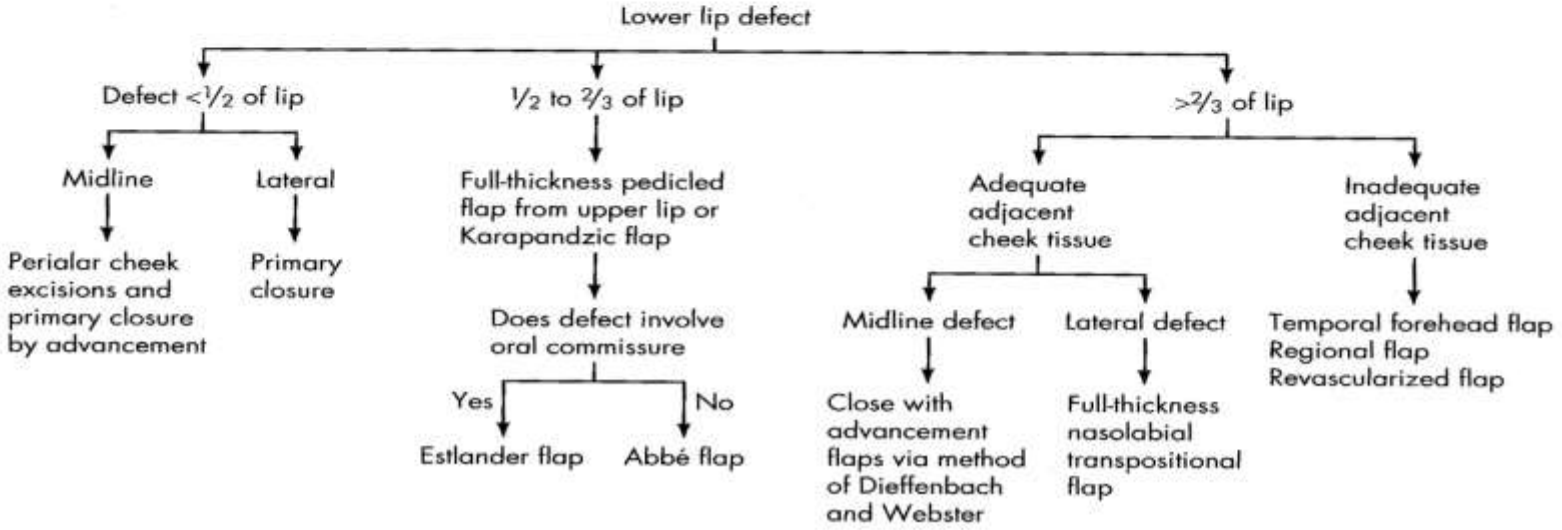


Figure 18-51 Algorithm for reconstruction of upper lip defects.



Reconstruction - lip anatomy

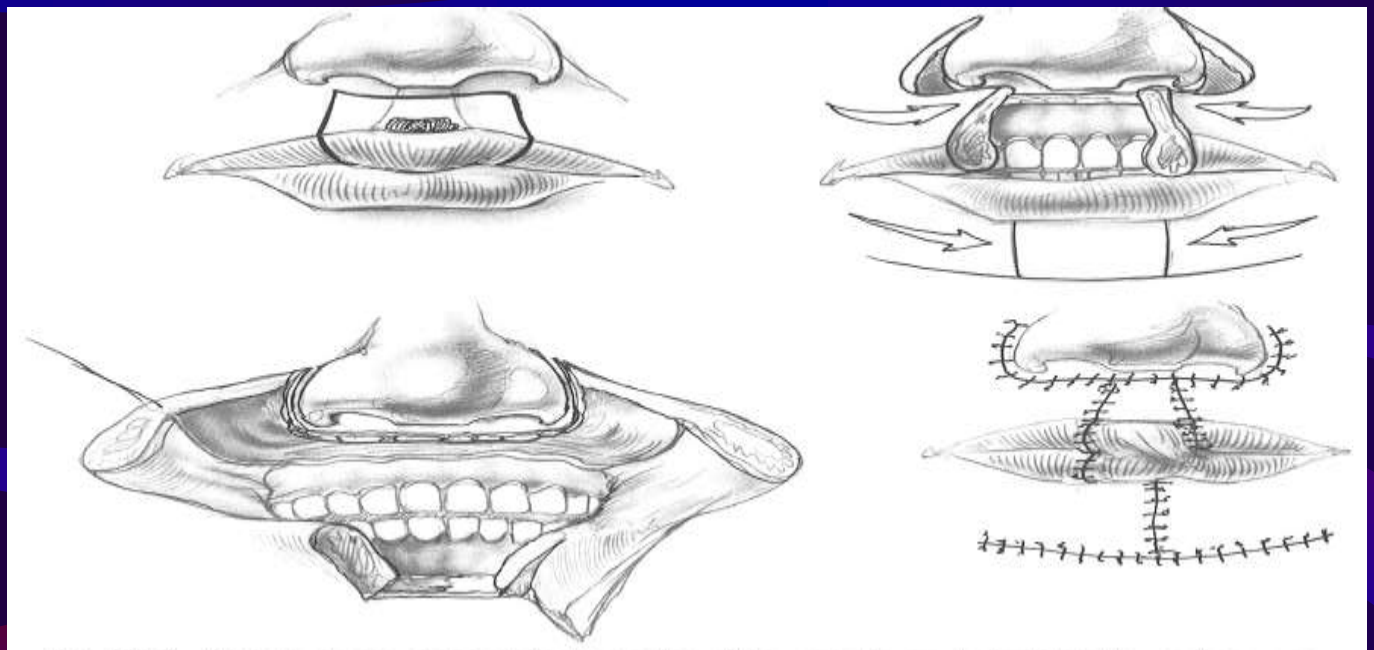


FIG. 106-3. Primary closure of defects in the midline of the upper lip can be facilitated by excising crescents of cheek skin in the perialar regions. An Abbe flap can be added in the midline if the wound closure is under excessive tension.

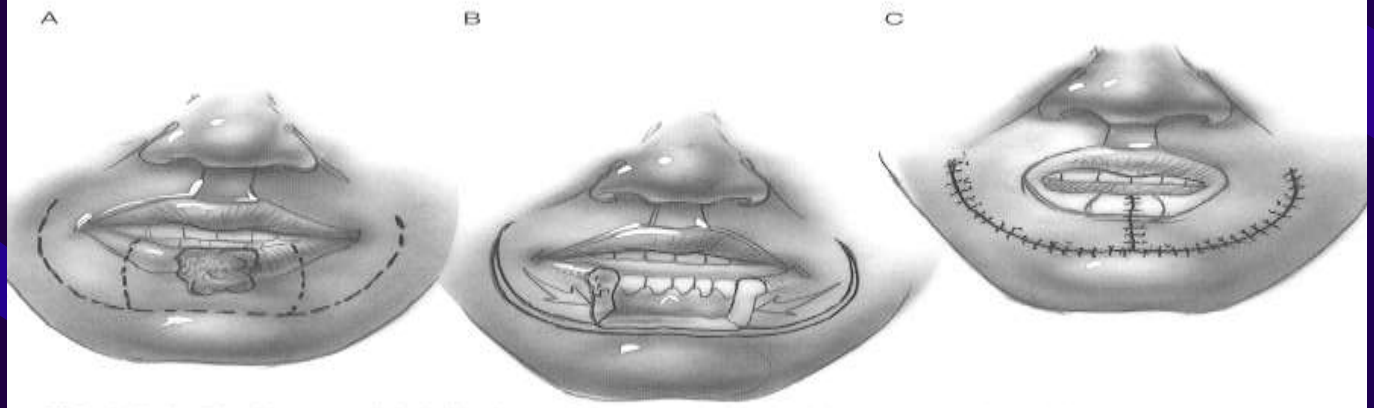
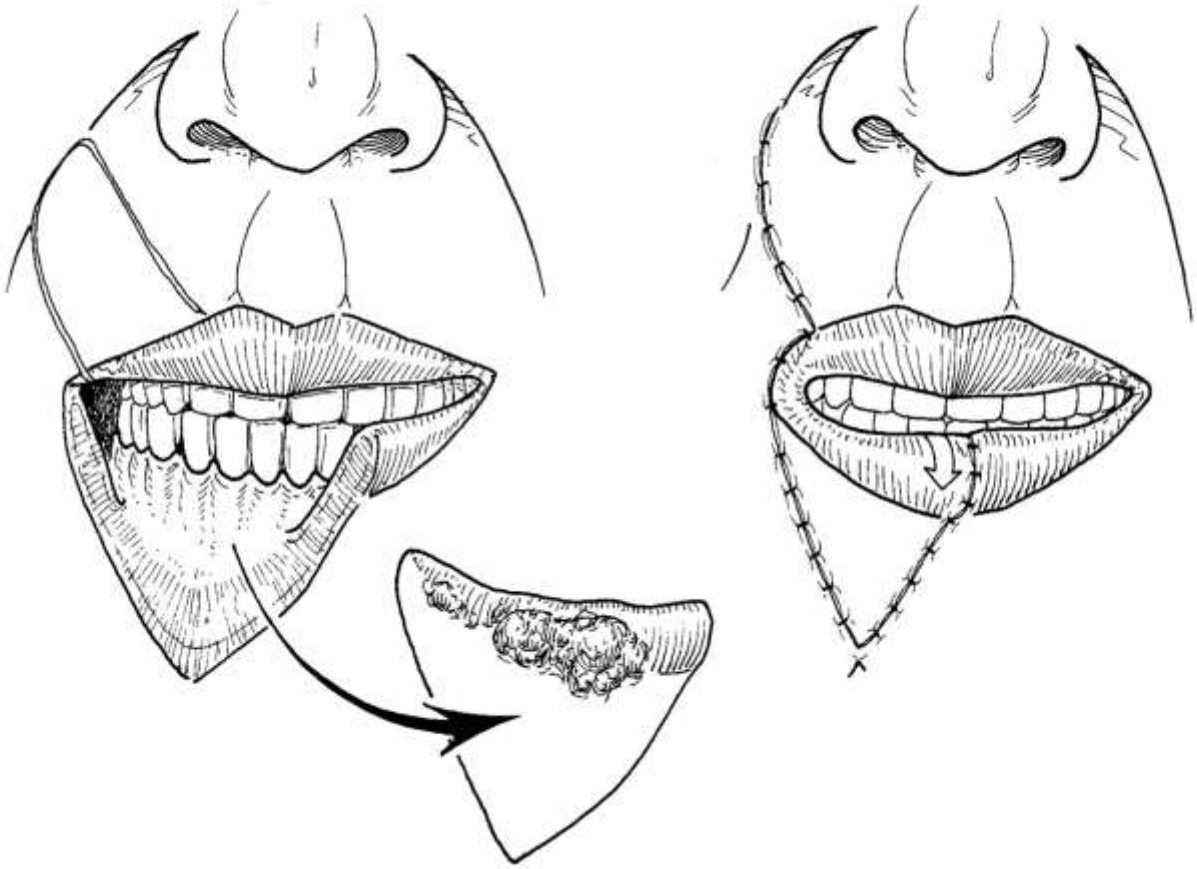


FIG. 106-4. The Karapandzic labioplasty. Circumoral skin incisions are made within the nasolabial and mental creases. The orbicularis oris muscle is bluntly dissected from supporting perioral muscles, taking care to preserve the neuromuscular pedicles, which enter from the periphery. The oral mucosa usually does not require transection.

Reconstruction - lip anatomy

Figure 18-38 Estlander type of cross-lip flap, shown here with a more rounded apex of the donor flap; most are triangular in design.



Summary

- Mohs technique very useful
- Reconstruction based upon patients desires and health
- Reconstruction based upon aesthetic units and subunits of face
- Reconstruction from very straightforward to very complex

Case Presentation

- 45 yr old man presents after excision of BCCA left temple region, circular defect measuring 38 X 42mm

Case Presentation

Case Presentation

- Pt o/w healthy
- agrees to more surgery
- desires to look as close to normal as possible, plans to wear beard
- No smoking, NSAID's, Diabetes

Case Presentation

Case Presentation

- Nondistortable landmarks - hairline, beardline, eyebrow, eyelid
- Lender units - forehead, cheek
- Available skin arc or rotation 180 degrees, central portion unavailable, aprox. 2 diameters on forehead and cheek

Case Presentation

- Possible flaps - note, rhomboid, bilobed, O-Z, O-T, V-Y, subcutaneously pedicled
- V-Y, Sub - Q can have tenuous blood supply
- Because skin available on both sides, A-T, and O-Z good choices
- Can hide A-T incision in hairline

Case Presentation

Case Presentation