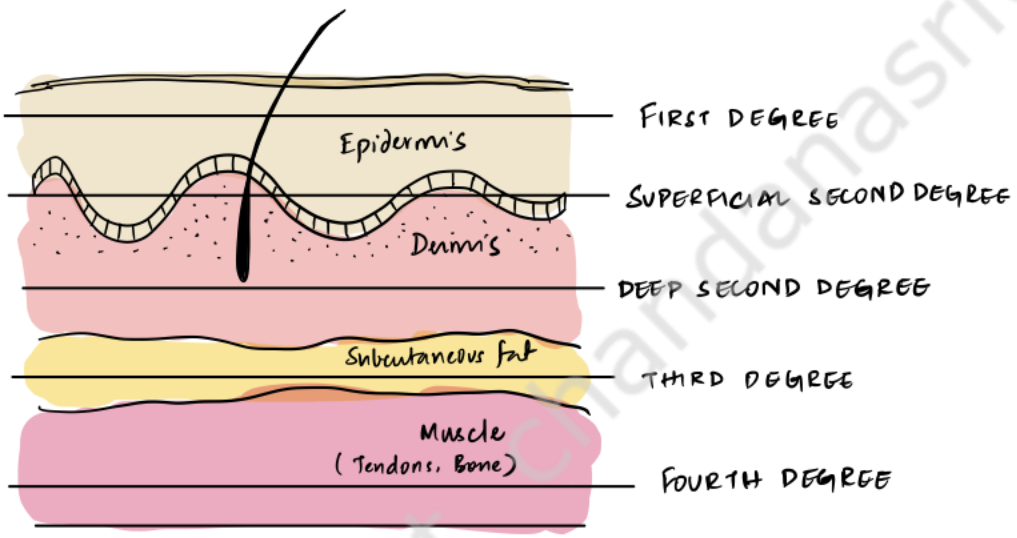
BURNS

A burn is an injury to skin / other tissues primarily caused by heat or due to radiation, radioactivity, electricity, friction or contact with chemicals

ETIOLOGICAL CLASSIFICATION

- THERMAL
  - FLAME BURNS
    - m/c
    - Highest mortality
  - CONTACT BURNS
  - SCALDS
  - COLD INJURY
- ELECTRICAL
  - LOW TENSION
  - HIGH-TENSION
- CHEMICAL
- RADIATION
  - LOCAL
  - SYSTEMIC

• CLASSIFICATION BASED ON BURN DEPTH



Depth of burn depends on - contact time
- temperature

Assessed by
- Clinical judgement of an experienced practitioner
- Multisensor Laser Doppler flowmeter → helps determine areas requiring excision & skin grafting
- Thermography
- In-vivo videomicroscopy
- Near infra-red spectroscopy

- 1° BURNS - Confined to epidermis - intact epidermal layer
  Painful, erythematous
  Do not blister
  Do not scar
  } Eg: Sunburns, minor scalds

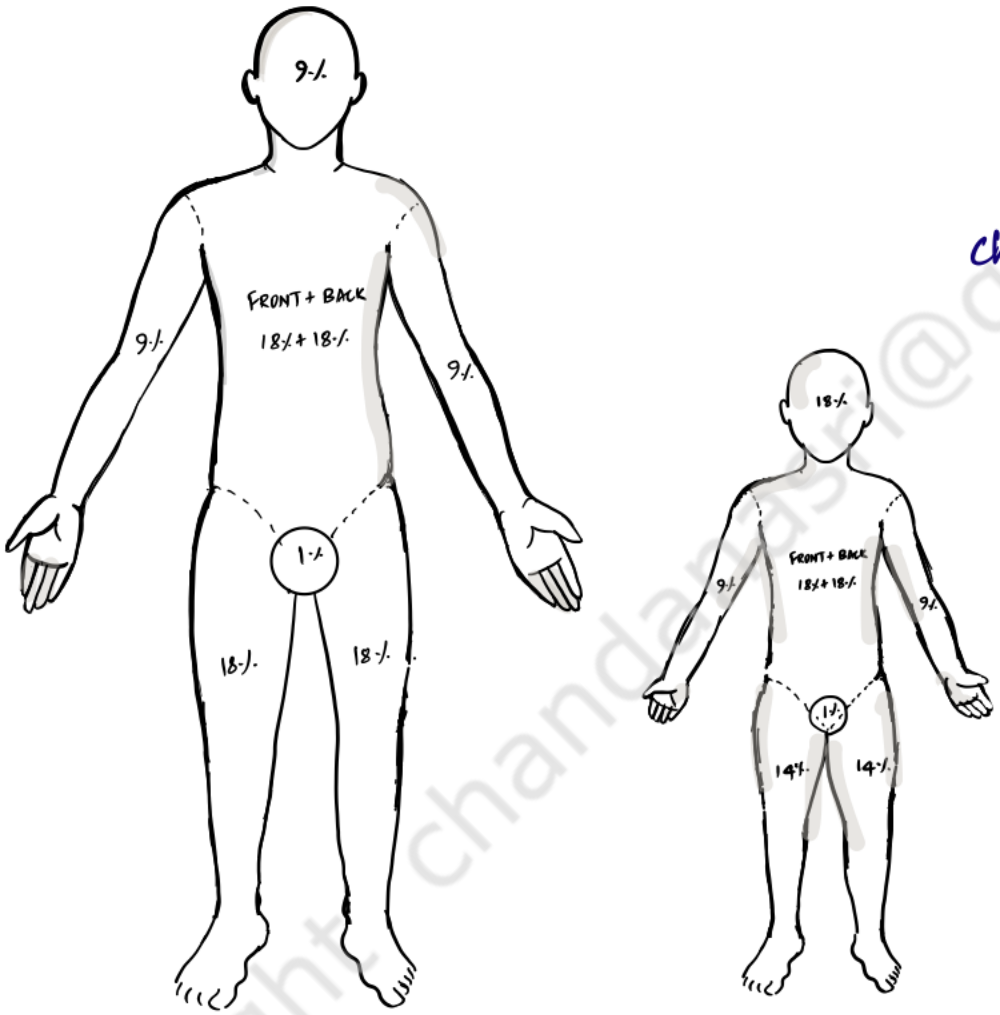
- 2° BURNS - Dermal Involvement
  Extremely painful
  Weeping (+), Blisters (+)
  SCARRING (+)
  - Superficial - re-epithelise spontaneously in 1-2wk from retained epithelial structures in rete ridges
  - Deep - pale, mottled, do not blanch
    - re-epithelize from hair follicles in 2-5wks

- 3° BURNS - Leathery, painless, non blanching - eschar (+), re-epithelisation from wound edges - will need excision & grafting

BURN SIZE

- Estimates the extent of injury
- Burn size is expressed in terms of % of TBSA
  Open hand- palm + extended fingers ≃ 1% TBSA

WALLACE RULE OF NINES



Children have greater surface area over their heads than adults

Other methods employed to estimate burn size
- Lund & Browder chart
- Berkow formula

UTILITIES OF ESTIMATING BURN SIZE

① CALCULATION OF FLUID REQUIREMENTS AND FEEDING FORMULAE

② PROGNOSIS - BAUX SCORE : MORTALITY RISK = AGE + TBSA %
Revised Baux Score - Age, Burn size, inhalational injury

PATHOPHYSIOLOGY

① BURN WOUND

Jackson's Burn wound model

- Zone of Coagulation - central part closest to the point of contact
  - most severe damage
  - irreversible coagulative necrosis

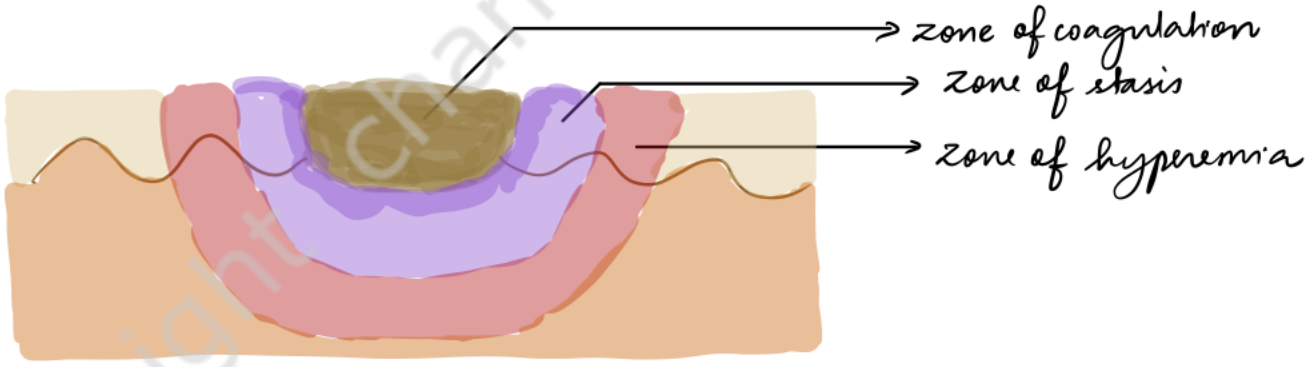
- Zone of stasis : - area surrounding the zone of coagulation
  - characterised by decreased tissue perfusion (THROMBOXANE A_2 mediated)

  → potentially salvageable - failure to salvage → conversion to zone of coagulation

  aim of effective resuscitation is to allow this zone to recover by restoring capillary microcirculation
  - re-establish tissue perfusion
  - limit the production of free radicals

- Zone of hyperemia: characterised by vasodilatation from inflammation surrounding the burn wound.
  - clearly viable tissue from which the healing process begins
  - generally NOT at risk of necrosis

  ↓ can involve the entire body in extensive burns (> 25% TBSA)



② SYSTEMIC RESPONSE : Seen in major burns (>20-30% TBSA)

→ Reduced Cardiac Output
- Decreased myocardial contractility
- Decreased venous return (↓ preload)
- Increased afterload due to ↑ Systemic vascular resistance
  - Catecholamines & Sympathetic activity
  - ADH, angiotensin II, neuropeptide y

→ Pulmonary edema - Direct injury d/t inhalation
- ↑ Pulmonary vascular resistance
- ↑ Capillary pressure & capillary permeability
- Left heart failure
- Hypoproteinemia

→ Renal - ↓ perfusion

→ Metabolism - CATABOLIC RESPONSE
↑ Catecholamines, Glucagon, Dopamine 2/t ↑ IL-1, IL-6, PAF, TNF, ROS, Complement activation

First phase - within 48 hours of burn injury - EBB phase - ↓CO, metabolism
Flow phase - 5 days after injury → hyperdynamic circulation & hypermetabolic state
- lasts for variable periods - depends on various factors
↑ Protein Catabolism

Downregulation of cell mediated & humoral responses

→ Gastrointestinal - microvascular damage, ischemia to gut mucosa → ↓ Gut motility
- Mucosal atrophy - begins in 12 hrs
Stress ulceration - Curling's ulcer
Gut stasis, ↑ Gut permeability
Acalculous cholecystitis

Failure of peripheral circulation: Tourniquet effect 2/t to inelastic denatured collagen in full thickness extremity burns
- Compartment Syndrome

(3) BURNS EDEMA

- Increased capillary hydrostatic pressure - vasodilatation & venoconstriction
- Increased capillary permeability - due to inflammatory mediators, peaking at 3-6 hrs, leading to
- Decreased plasma oncotic pressure - loss of circulating albumin into tissue spaces
- Increased tissue oncotic pressure
- Decreased tissue hydrostatic pressure
- Generalized impairment in cell membrane function

Greater the depth of burns, longer the persistence of edema

MEDIATORS OF BURN PATHOPHYSIOLOGY

- Histamine
- Prostaglandins, Leukotrienes, Thromboxanes
  PGE_2, PGI_2 / TXA_2
- Free radicals - Reperfusion injury
- Angiotensin II, Vasopressin
- Nitric oxide

BURN INJURY TO AIRWAY & LUNGS

- Physical burn injury to airway above larynx

Hot gases / fumes - damage to nose, mouth, tongue, palate, larynx

Supraglottic airway burns → edema of mucosal linings → Airway blockade

- Subglottic airway

- Steam - high latent heat of evaporation → loss of respiratory epithelium → Casts → Airway blockade

- Inhaled smoke particles
  - chemical alveolitis
  - respiratory failure

- Inhaled Carbon monoxide
  - metabolic poisoning

CO binds with Hb (240x greater affinity than O_2) to form Carboxyhemoglobin

levels > 10% → dangerous

R_x - 100% O_2 ≥ 24 hrs

> 60% → Death

- Inhaled Hydrogen Cyanide (produced in house fires)

Causes metabolic acidosis by interfering ē mitochondrial respiration

- Full-thickness burns to the chest → mechanical blockage to rib movement

IMMUNE SYSTEM & INFECTION

- Cell mediated immunity - significantly reduced in large burns

↑ Susceptibility to bacterial and fungal infections

- Gut mucosal ischemia - translocation of gut bacteria
- Loss of barrier function of skin

MANAGEMENT

IMMEDIATE CARE OF BURN PATIENT

- Prehospital care

1) Stop the burning process
2) Rule out other major immediately threatening injuries - ABC
3) Cool the burn wound - but avoid hypothermia - avoid ice cold water

   Initial wound management - wound toilet : saline (antiseptics only if grossly contaminated)
4) Give oxygen - especially in closed-space burns
5) Elevate

HOSPITAL CARE

Primary survey

A irway
B reathing & Ventilation } early elective intubation in select cases | Invasive airway
C irculation - secure cannulae, apply pressure to actively bleeding wounds
D isability
Exposure : Environmental control - full inspection
F luid resuscitation

CRITERIA FOR ADMISSION TO A BURNS UNIT

1) Partial thickness burns >10 % in children
   >15 % in adults
2) Full thickness / deep partial thickness burns
3) Burns involving face, hands, feet, genitalia, perineum, major joints
4) Burns requiring decompression
5) Electrical Burns, including lightning injury
6) Chemical burns
7) Inhalation injury
8) Burns at extremes of age, unless minor
9) Adverse psychosocial issues

FLUID RESUSCITATION

Goal - Maintenance of intravascular volume to perfuse
- essential viscera - brain, kidneys, gut
- peripheral tissues - skin

Intravenous resuscitation is given in >15% TBSA burns in adults
>10% TBSA burns in children

When oral fluids are used, salt must be added

PARKLAND FORMULA - for first 24 hrs

→ 4ml / Kg Body Weight / % TBSA

- ½ → First 8 hours
- ½ → Next 16 hrs

Fluid of choice - RL

→ +50% more fluid i/c/o - inhalational injuries
- electrical injuries
- pre-existing dehydration

Children will need maintenance fluid in addition to the resuscitation volume in the first 24 hours - **HOLLIDAY - SEGAR FORMULA**

4ml / Kg / hr for 1st 10 Kg
2ml / Kg / hr for next 10 kg
1ml / Kg / hr for every Kg after that

5D → "Free water"

Fluid Creep - in acute burn resuscitation
└ Due to overzealous fluid resuscitation

FLUID RESUSCITATION FORMULAS

FORMULA	FLUID IN FIRST 24 hrs	FLUID IN SECOND 24 hrs	
		COLLOID	CRYSTALLOID
PARKLAND (Baxter formula)	RL 4 mL / Kg / TBSA % Burns ½ over 8 hr ; ½ over 16 hrs (+ Maintenance acc to 4-2-1 rule) in children	20-60% estimated plasma volume	5D Titrated to U/O of 30 ml/h (0.5-1 ml/Kg/hr)
MODIFIED PARKLAND	⟶‖⟵	5% albumin at 0.3 ml/Kg/% TBSA burn	
EVANS	NS 1 mL/Kg/TBSA 5D 2000 mL Colloid 1 mL/Kg/TBSA	0.5 ml/Kg/% TBSA burn	0.5 ml/Kg/% TBSA burn + 2000 mL 5D
SLATER	RL - 2L / 24 hr FFP - 75 ml / Kg / 24 hr		
BROOKE	RL 1.5 mL/Kg/TBSA % Colloid 0.5 mL/Kg/TBSA % 5D 2000 mL	0.5 ml/Kg/% TBSA burn	0.25 ml/Kg/% TBSA burn + 2000 mL 5D
MODIFIED BROOKE	No Colloids RL - 2 mL/Kg/TBSA % (Adults) 3 mL/Kg/TBSA % (Children)	0.3-0.5 ml/Kg/TBSA %	5D added to maintain U/O
GALVESTON (Preferred in children)	RL - 5000 mL/m² Burn area + 1500 mL/m² total area ½ - 8 hr ; ½ - 16 hr	Body surface area is used instead of body weight	

MUIR BARCLAY FORMULA - First 36 hrs are divided into 6 periods: 3 x 4 hr, 2 x 6 hr, 1 x 12 hr
- Was described for ALBUMIN
- Each period - 0.5 mL/Kg BW/% TBSA burn

CRYSTALLOIDS

- RL / Hartmann's Solution – m/c used fluid
- NS -
- 5D → source of free water & glucose
- Hypertonic saline - may be of value in large burns ∵ inhalational injury
  hypertonicity - may help improve intravascular volume

DANGERS: shift of intracellular fluid into extracellular space
central pontine myelinosis

ADVANTAGES- less tissue edema
- may decrease need for INTUBATION
ESCHAROTOMY

CRYSTALLOIDS are the preferred resuscitative fluid in the first 24 hours
∵ Edema fluid in burns is ISOTONIC
contains same amount of protein as plasma
greatest loss of fluid is into the interstitium

∴ Colloid solutions should not be used in the first 24 hours
until capillary permeability has returned to normal
- some say normal capillary permeability is restored earlier (at 6-8h)
& therefore colloids may be used.

COLLOIDS

Human albumin solution - m/c used colloid – acc to Muir Barclay formula

Others- Dextran 40 & 70

Indicators of Resuscitation

1. Urine output - 0.5-1 ml/kg/hr
2. Hematocrit
3. Acid base balance
4. Central venous pressure
5. TEE- filling pressure

NUTRITION IN BURNS

Burns are acutely catabolic

↑ Nutritional requirements in >15% TBSA burns (>10% in children)

↓

Nasogastric tube for feeding

- start feeding within 6hrs of injury to ↓ gut mucosal damage

① CURRERI FORMULA

DAILY CALORIC REQUIREMENT (in kCal)

Age 16-60y	>60y
25 (Weight) + 40 (% TBSA burns)	20 (Weight) + 65 (% TBSA burns)

② SUTHERLAND FORMULA

DAILY CALORIC REQUIREMENT

Children	Adults
60 kCal/kg + 35 (% TBSA burns)	20 kCal/kg + 70 (% TBSA burns)

③ Hildreth formula
④ Harris Benedict formula

Protein requirements- Peak Nitrogen losses - 5-10 days post burn
20% of total daily caloric requirement - Protein

DAVIES FORMULA

DAILY PROTEIN REQUIREMENT

Children	Adults
3g/kg + 1g (% TBSA burns)	1g/kg + 3g (% TBSA burns)

- High carb/ low fat diets → ↓ Proteolysis - but watch for hyperglycemia
- Glutamine supplementation - beneficial

HORMONES: recombinant GH, anabolic steroids (Oxandrolone)
IGF-1, Propranolol (anticatabolic therapy)

- Can be monitored by
  - Body weight
  - Nitrogen balance

Pre-albumin	Respiratory
Albumin	Quotient

BURN WOUND CARE

BURN WOUND DRESSINGS

MATERIAL	ADVANTAGES	DISADVANTAGES
ANTIMICROBIAL SALVES		
1. SILVER SULFADIAZENE	Broad spectrum antimicrobial painless easy to use	• Does not penetrate eschar • Silver ion – Black tattoo • mild inhibition of epithelization • Transient leucopenia (3-5d)
2. MAFENIDE ACETATE	Broad spectrum antimicrobial PENETRATES ESCHAR due to carbonic anhydrase inhibition	• causes pain in sensate skin • wide application can cause metabolic acidosis • mild inhibition of epithelization
3. BACITRACIN, NEOMYCIN, POLYMYXIN B	Ease of application Painless	Antimicrobial spectrum not very wide
4. NYSTATIN	Inhibits most fungal growth	cannot be used ī mafenide acetate
5. MUPIROCIN	• Effective anti. Staph coverage • Does not inhibit epithelization	expensive
ANTIMICROBIAL SOAKS		
1. 0.5 /. Silver nitrate	Wide antimicrobial spectrum	Stains leaches Na from wounds Methemoglobinemia
2. MAFENIDE ACETATE 5 /.	Wide antibacterial	No fungal coverage painful Metabolic acidosis
3. 0.025 /. SODIUM HYPOCHLORITE (DAKIN)	Wide antimicrobial spectrum esp gram +	Hypochlorite is inactivated by protein ↓ Regular change in dressing required
4. 0.25 /. ACETIC ACID	Wide antimicrobial spectrum esp gram –	mildly inhibit epithelization

SURGERIES FOR BURNS

ACUTE BURN WOUNDS

Aim - removal of non viable tissue
- source of inflammatory mediators
- nidus for bacteria

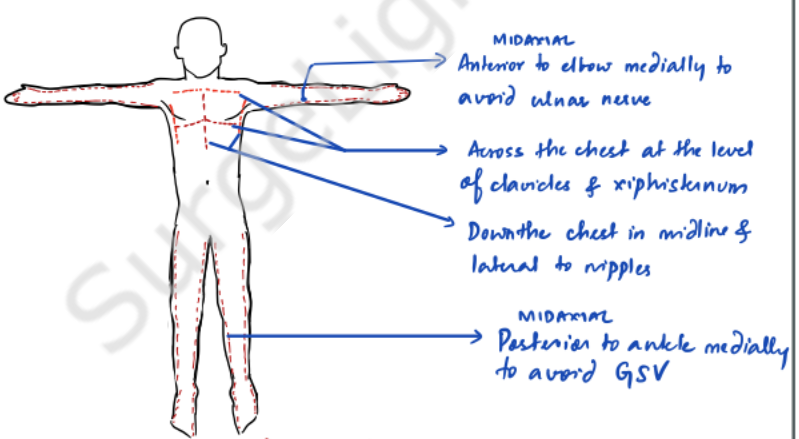
- appropriate wound cover / closure

Indications

- Deep dermal and full thickness burns (>4cm²)
- Eschar causing tourniquet effect & compartment syndrome

ESCHAROTOMY

- Deep 2° / 3° burns encompassing the circumference of torso / extremity
↓
Development of non yielding eschar
↓
edema
↓
impedes venous outflow
↓
Impedes arterial inflow
↓
Compartment Syndrome



---- Recommended escharotomies

Entire eschar must be incised longitudinally

FASCIOTOMY

- In the presence of elevated muscle compartment pressures
↓
Fasciotomy

General rule

- Extend the incision beyond the deep burn
- Adequate hemostasis

TANGENTIAL EXCISION

Using Braithwaite / Watson / Goulian Knife
↓
Repeated shaving of deep dermal partial thickness burns
↓
until viable dermal bed is reached
↓
Punctate bleeding from dermal wound bed

Topical adrenaline 1:500,000 solution to reduce bleeding

TOTAL BURN EXCISION

For full thickness burns
↓
Excision of the entire skin until freely bleeding subcutaneous tissue is visualised
↓
viable fat
↓
Whenever possible, a skin graft must be applied immediately

Blisters - removal vs preservation

→ blister fluid may
- depress immune function, slowing down chemotaxis & intracellular killing
- act as medium for bacterial growth

→ leaving blisters intact forms a sterile stratum spongiosum

WOUND COVER

Choice depends on
- size and depth of wound
- Level of contamination
- Vascularity of wound bed

AUTOGRAFTS

Autografts from uninjured skin

Full thickness skin grafts - for face, fingers

SSG for other areas

Strategies to maximise donor site
- Meshing
- Reharvesting - after 2-3 wks

Strategies to improve graft expansion
- Meek grafting
- Micrografting
- Intermingling micrografting

Cultured epithelial autografts
↓
Keratinocytes cultured from skin biopsy

ALLOGRAFTS

• CADAVERIC ALLOGRAFT

'Biological dressing' in case of extensive burns (>40% TBSA) where autografts are impractical / insufficient
- To temporarily cover debrided burn wounds when there is insufficient donor site skin.
- Sandwich graft (+ autograft)

Graft 'take' occurs by adhesion of wound fibrin to graft elastin
↓
- Coverage reduces fluid & electrolyte & protein loss
- ↓ Inflammation
- ↓ Wound infection
- Rejection occurs by foreign body reaction
- Risk of disease transmission

• ACELLULAR HUMAN DERMAL ALLOGRAFT

XENOGRAFTS

Porcine skin
Bovine skin
Frog skin
Act in a similar fashion to cadaveric allografts

PORCINE 'DERMIS' is commonly used.
Porcine dermis is not invaded by human capillaries
↓
Neutrophilic infiltration
↓
dressing dries & falls off as the skin heals

• Amniotic Membrane
↓
- Good barrier function
- low immunogenicity
- transparency allows wound surveillance

SYNTHETIC COVERINGS

OPSITE - semipermeable, semiocclusive transparent, adhesive polyurethane film

BIOBRANE - synthetic bilaminar material
- Nylon mesh coated ± type I porcine collagen
- Silicone

TRANSCYTE - nylon polymer mesh coated ± neonatal human fibroblasts bonded to silicone

INTEGRA - Skin substitute
- 'epidermal' silicone layer
- collagenous dermal replacement layer (BOVINE)
- provides complete wound closure & leaves a dermal equivalent

ADLIGRAF - Bovine type I Collagen + living neonatal fibroblasts + neonatal Keratinocytes

BURN SCAR MANAGEMENT

Strategies to minimise scarring

① Optimise timely healing - appropriate dressings
- early wound excision
- wound closure

② Physiotherapy & splinting in functional position

Principles of scar management

- Massage, pressure garments
- Topical Rx
  - Steroid injections
  - Silicone
  - Laser - Pulsed Dye Laser
- Avoid permanent joint changes by early scar release

BURN CONTRACTURE

Myofibroblasts - responsible for wound contraction
- appear on D_3
- Peak on D_{10}

- Contracture is a pathological process occuring in a scar that has already re-epithelized / healed causing shortening, deformity and limitation of movements.

Types
- Intrinsic
  - ↓
  - Eg. Scarring of eyelid
  - ↓
  - Ectropion
- Extrinsic
  - ↓
  - Normal eyelid pulled down by cheek scar contracture
  - ↓
  - Ectropion

- generally affect concavities - Neck
  Axilla
  Web spaces of digits
  Flexor surfaces of joints

General Management

- Incisional release
- Full scar excision

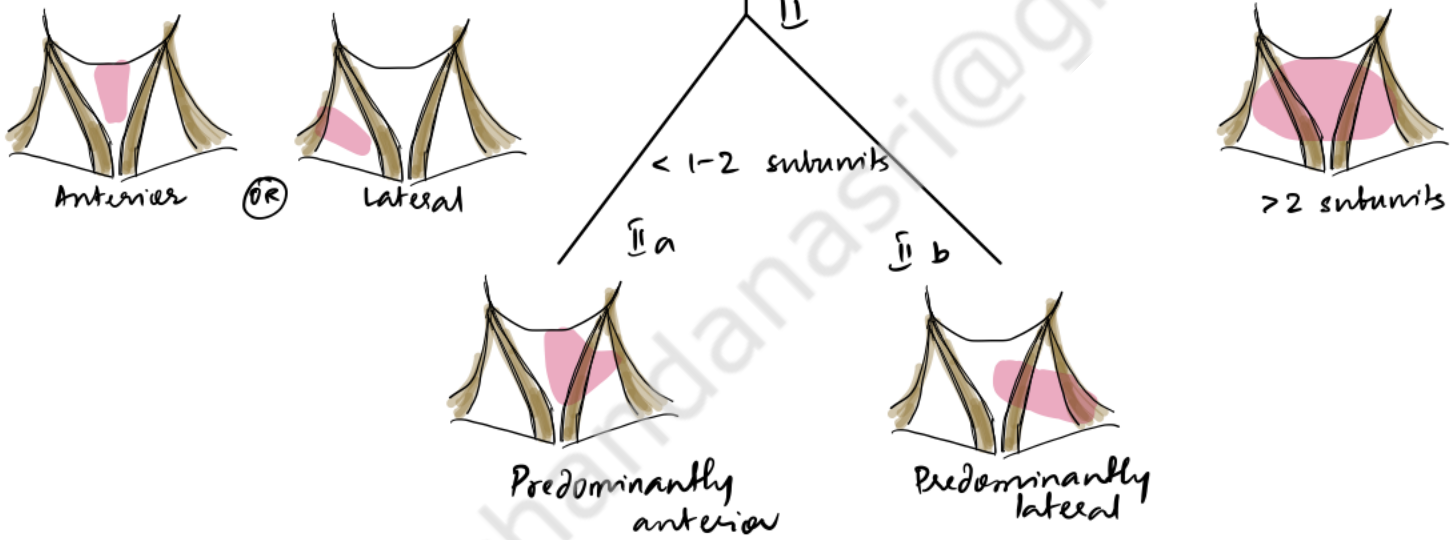
} → Soft tissue cover (Graft / Flap) → Splinting physiotherapy

± Tenolysis

NECK CONTRACTURES

GRADES
- Mild → < 1/3rd – cannot see ceiling
- Moderate → 1/3rd – 2/3rd – Can flex, cannot extend
- Severe → > 2/3rd – fully contracted in flexed position
- Extensive → Mentosternal adhesions

TYPES OF NECK CONTRACTURES



CORRECTION OF NECK CONTRACTURES

1) Grafts – Thick SSGs / FTSG or Dermal Matrix
   - Freshen the neck wound
   - Release contractures
   - Cover the defect i SSG
   - Post-operative splinting

2) Flaps
   - Random neck flaps – Z plasties for narrow webs / bands
   - Pedicled flaps – SUPRACLAVICULAR FLAP, TRAPEZIUS FLAP } based on branches of Transverse Cervical Artery
   - Free flaps – thin perforator flaps – Anterolateral thigh flap

BASAL CELL CARCINOMA

BCC - Malignant tumor composed of cells derived from the pluripotential cells of the epidermis / outer root sheath of the hair follicle.
Found almost exclusively on hair-bearing skin
Facial skin affected more due to greater density of pilosebaceous units

EPIDEMIOLOGY

- m/c non melanoma skin cancer
- No known precursor lesion
- 95% occurs in 40-80y
- M:F 2:1

RISK FACTORS

- UV radiation - intense intermittent exposure
  - Sun exposure - incidence ↑ i proximity to equator
  - PUVA treatment for psoriasis is a risk factor
- Ionising radiation - sites of prior radiotherapy
- Immunosuppression - Psoralen, PUVA
- Chemicals - Hydrocarbons, Coal tar, arsenic
- Genetic skin cancer syndromes - Basal cell nevus syndrome / Gorlin Syndrome
  Multiple basal cell carcinoma syndromes - Xeroderma pigmentosa
  Muir torre syndrome
- 90% linked to mutations in hedgehog signalling pathway, mutations of PTCH 1 gene (tumor suppressor)

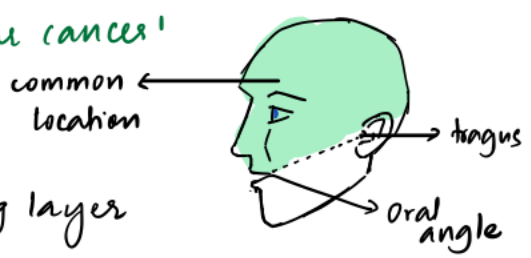
CLINICAL FEATURES

- Slow growth rate
- Commonly infiltrates locally → including muscle, cartilage, bone
- Metastasis rare

} 'Primary site will often undergo resection multiple times before metastases appear

- Location - Head & neck - especially face
  'H' zone / Mask area

'Tear cancers'



- 'RODENT ULCER'

HPE: Ovoid cells in nests with a single palisading layer
- Only outer layer cells actively divide
  ↓
  Slow progression; incompletely excised lesions are more aggressive

TYPES OF BCC

NODULAR

- m/c variant
- ~ 60 %.
- Round, pearly, flesh colored papule
- ± telangectasias

↓

Ulceration

↓

Raised pearly borders

- CYSTIC → Mucin filled
- PIGMENTED → Brown / Black macular areas; DDx - Melanoma
- KERATOTIC

MICRONODULAR BCC

aggressive

not prone to ulceration

appears yellow-white when stretched

SUPERFICIAL

~30 %.

m/c variant of BCC

Seen on upper trunk / shoulders

↓

minimal tendency to be invasive

- erythematous well circumscribed patch / plaque (may mimic psoriasis or eczema)

Often multicentric ± areas of normal skin between plaques

- MULTIFOCAL
- SUPERFICIAL SPREADING

MORPHEAFORM

↓ ~10 %.

Sclerosing BCC

↓

Fibroblast proliferation within dermis

↓

↑ Collagen deposition

- Flat / slightly depressed
- Firm, Fibrotic plaque Yellowish white
- Rarely ulcerates / bleeds / crusts
- Commonly mistaken for scar tissue

OTHER

1) Infiltrative

tumor infiltrates dermis between collagen fibres

↓

tumor margins are clinically less apparent

- higher recurrence rate

2) BASOSQUAMOUS CELL CARCINOMA

- rare
- aggressive
- elevated levels of collagenase

↓

spread rapidly

HIGH RISK FEATURES

1) Large - >2cm (in low risk area) >1cm (in high risk areas)
2) Located at sites where direct invasion gives access to the cranium - Near - eye, nose, ear
3) Poorly defined borders
4) Recurrent tumors
5) Tumors forming in the presence of immunosuppression / at the site of prior RT
6) Micronodular / infiltrating histological subtypes, perineural invasion

STAGING (For all cutaneous Ca of H & N)

T

- Tx - can't be assessed
- Tis - in situ
- T1 - ≤ 2cm
- T2 - 2-4cm
- T3 - >4cm / Deep invasion / Minor bone/perineural inv
- T4 - T4a - cortical bone / marrow inv; T4b - skull base inv

N

- N1 - ≤3cm, ⊖ENE
- N2 - N2a - single, ipsilateral 3-6cm; N2b - multiple ipsilateral <6cm; N2c - B/L / contralateral <6cm
- N3 - N3a - >6cm, ENE ⊖; N3b - ENE ⊕

M

M0 - No distant mets; M1 - distant mets ⊕

Grouping

- 0 - Tis N0 M0
- I - T1 N0 M0
- II - T2 N0 M0
- III - T3 N0 M0; T1,2,3 N1 M0
- IV - T1,2,3 N2 M0; Any T N3 M0; T4 Any N M0; Any T Any N M1

MANAGEMENT

Lesion suspicious of BCC

↓

Complete skin examination - assess & mark tumor and surrounding surgical margin using LOUPE MAGNIFICATION

↓

Excision

- Well circumscribed BCC < 2cm diameter (LOW RISK) ⟶ 4mm margin (4-6mm)
- High risk lesions ⟶ 10mm margins
- Excision ± complete circumferential peripheral & deep margin assessment – FLAP COVER (LOCAL / DISTANT)

- MOHS MICROGRAPHIC SURGERY (MMS)

  Sequential, tangential excision of cutaneous malignancies with immediate pathological assessment of margins

  Most useful in - recurrent cases
  size >2cm
  in high risk sites - ear, eyes, lips, nose, nasolabial folds

- Curettage & Electrodessication

  alternatingly scraping away tumor tissue with a curette down to a firm layer of normal dermis and denaturing the area by electrodessication

  - for superficial lesions
  - should not be used in areas ± TERMINAL HAIR GROWTH (→ scalp, pubis, axilla, male beard area) - tumor extending down follicular structures may not be adequately removed
  - if subcutaneous tissue is reached - excision should be performed (→ soft, does not reliably help to diff tumor vs normal tissue)
  - does NOT allow histological margin assessment

- RADIATION THERAPY

  Primary RT - reserved for older patients (unfit for Sx) ± low risk lesions
  ~60Gy

  Adjuvant RT - Perineural inv, ↑ risk of recurrence, margins +ve

  RT is contraindicated in genetic conditions predisposing to skin cancer - Basal cell nevus so
  - in connective tissue disorders - Scleroderma

- SUPERFICIAL THERAPIES - lower cure rates; reserved for pts in whom Sx/RT not feasible
  - Topical Rx ± Imiquimod
    5FU
  - Photodynamic therapy - MAL, ALA
  - Cryotherapy
  - Intralesional interferon (INFα2b)

- SYSTEMIC Rx: Vismodegib, Sonidegib (Hedgehog pathway inhibitor)

SQUAMOUS CELL CARCINOMA (CUTANEOUS)

SCC - Malignant tumor of the epidermis and its appendages, whose cells show maturation towards Keratin formation

- arises from stratum basalis of the epidermis
- expresses CYTOKERATINS 1 & 10

EPIDEMIOLOGY

- 2nd m/c cutaneous carcinoma
- m/c c/c of death from NMSC
- M > F, middle aged, fair skinned

RISK FACTORS

- UV radiation - cumulative sun exposure and damage
  - Sun exposure - incidence ↑ i proximity to equator
  - PUVA treatment for psoriasis is a risk factor
  - Tanning booths
- Ionising radiation - sites of prior radiotherapy
- Immunosuppression (for solid organ transplantation) (100 fold ↑ risk)
  - more aggressive, ↑ recurrence
- Chemicals - Hydrocarbons, Coal tar, arsenic
- Genetic skin cancer syndromes
  - Xeroderma pigmentosum
  - Albinism
  - Muir Torre SO
  - Dystrophic Epidermolysis Bullosa
  - Fanconi anemia
- CHRONIC INFLAMMATION
  - Chronic sinus tracks
  - Pre-existing scars — SCC in a scar - MARJOLIN'S ULCER
  - Burns
  - Osteomyelitis
  - Vaccination points
- HPV 5 & 16, 18 - anogenital SCC
  - Epidermodysplasia verruciformis - HPV 5 & 8
  - Verrucous carcinoma - HPV - 6, 11
  - Periungual SCC - HPV 16

PREMALIGNANT / PRECURSOR LESIONS

1. CUTANEOUS HORN - clinical description for a dense cone of hyperkeratotic epithelium
   - appear on sun-exposed skin of older individuals

   Generally develops from
   - benign lesions like warts / Seborrheic Keratosis
   - premalignant lesions like Actinic Keratosis, SCC in situ
   - Malignant lesions like SCC

   15% of cutaneous horns demonstrate INVASIVE SCC at the base

2. ACTINIC KERATOSIS (AK) : premalignant lesions with potential to develop into SCC (20%)
   found mainly on sun-exposed areas - face, scalp, ears, lips
   - skin colored / erythematous / brown ill-defined patches ± adherent scales

   areas of permanent sun damage → dyskeratosis
   partial thickness cellular atypia
   Subepidermal inflammation
   intact basement membrane

3. KERATO-ACANTHOMA

   Rapidly growing, nodular tumors exhibiting symmetry around a central Keratin-filled crater ; may regress spontaneously

   M:F 2:1
   Face / limbs
   Chronically sun-damaged skin, fair skin
   50-70y
   ? HPV in a hair follicle during growth phase
   Smoking
   chemical carcinogen exposure

   Ddx - ANAPLASTIC SCC

   EXCISION RECOMMENDED

4. BOWEN'S DISEASE → SCC in situ
   develops as full-thickness dysplasia in hypertrophic AK

   slowly enlarging erythematous scaly plaque on any mucocutaneous surface
   (Glans : Erythroplasia of Queyrat)

   Rx - Topical 5FU
   Imiquimod
   Surgical excision ± 4mm margin
   Mohs Micrographic Sy

SCC has higher metastatic potential than BCC
Regional nodes - m/c site of mets
Distant - bone, brain, lungs
H&N → Parotid

Anatomical distribution

Head & Neck - 80%.
- Cheeks - 45%.
- Nose - 13%.
- Ear & Periauriculas - 12%.
- Neck - 10%.

- Hands - 11%.
- Trunk - 2%.
- Legs - 1%.
- Anus - 5%.

Macroscopy

- Smooth, nodular
- Verrucuous
- Papillomatous
- Ulcerative

→ All eventually ulcerate
- everted edge
- surrounding induration

MICROSCOPY - irregular masses of squamous epithelium invading dermis

CYTOKERATIN 1 & 10 ⊕

BRODER'S GRADING

I	Well differentiated	<25% undifferentiated cells
II	Moderately well differentiated	25 - 50% undifferentiated cells
III	Poorly differentiated	50 - 75% undifferentiated cells
IV	Anaplastic / Pleomorphic	>75% undifferentiated cells

PROGNOSTIC FACTORS

1) Depth of invasion - <2mm - metastasis unlikely
>6mm - 15% metastasis
2) Diameter: >2cm → poor prognosis
3) Grade: Higher Broder's grade - worse prognosis
4) Lymphovascular/ perineural invasion - poor prognosis
5) Site: Lips & ears - have higher local recurrence
Extremeties - poorer prognosis than trunk
6) Etiology:
SCCs from burns, OM, sinus, ulcer, irradiated skin → ↑ metastatic potential
7) Immunosuppression: greater invasion

STAGING

T

- T_x - can't be assessed
- T_{is} - in situ
- T_1 - ≤ 2cm
- T_2 - 2-4cm
- T_3 - >4cm / Deep invasion / Minor bone/perineural inv
- T_4
  - T_{4a} - cortical bone / marrow inv
  - T_{4b} - skull base inv

N

- N_1 - ≤3cm, ⊖ENE
- N_2
  - N_{2a} - single, ipsilateral 3-6cm
  - N_{2b} - multiple ipsilateral <6cm
  - N_{2c} - B/L / contralateral <6cm
- N_3
  - N_{3a} - >6cm, ENE ⊖
  - N_{3b} - ENE ⊕

M

M_0 - No distant mets ; M_1 - distant mets ⊕

Grouping

- 0 - Tis N0 M0
- I - T1 N0 M0
- II - T2 N0 M0
- III - T3 N0 M0
  T1,2,3 N1 M0
- IV - T1,2,3 N2 M0
  Any T N3 M0
  T4 Any N M0
  Any T Any N M1

EVALUATION

1) History
2) Head to toe examination - primary, nodal basins
3) CT/MRI for DOI, nodal evaluation
4) Biopsy - full thickness — punch / excision (2-8mm cylinder)

Shave biopsies

TREATMENT

1) Wide local excision
   - 4mm margin for low risk tumors
   - 6mm margin for high risk tumors

   → +ve margin → MMS or Re-excision or RT (if Sx not feasible)
2) Mohs Microscopic Surgery - in selected cases
3) Curettage and Electrodissection
4) Radiation — Primary / Adjuvant — ~60-70 Gy
5) Local
   - Topical - 5FU, Imiquimod
   - Photodynamic R
   - Cryotherapy

   } Generally reserved for premalignant / in-situ lesions
6) Management of nodal disease

H & N → (operable) Neck dissection → RT
H & N → (inoperable) RT

7) SYSTEMIC R
   - Cisplatin, Cisplatin + 5FU / Carboplatin
   - EGFR inhibitors - Cetuximab
   - Cemiplimab - anti PD-1

   } Adjuvant / locally advanced inoperable / metastatic

MALIGNANT MELANOMA

- arises from melanocytes - Neural crest origin
- can arise from SKIN, MUCOSA, EYES, LEPTOMENINGES
  - SKIN → melanocytes at the epidermal - dermal junction
  - MUCOSA → oropharynx, Nasopharynx, Proximal esophagus, anorectum, genitalia - female
  - EYES → choroid, retina
  - LEPTOMENINGES → epithelium of respiratory, GI & GU tracts

Epidemiology

- 2% of all skin cancers
- 80% of all skin cancer deaths
- Incidence ↑ i age

< 50y	> 70y
F > M	M > F
1.7 : 1	2.4 : 1

Overall lifetime risk for developing melanoma
M > F 1.5 : 1

RISK FACTORS

① SKIN TYPE : Caucasians - 20x risk compared to African americans
5x risk compared to American Hispanics
↓ i red/ blond hair, blue eyes
m/c in Fitzpatrick skin types I & II / pheomelanin predominant phenotype

② UV RADIATION

Intermittent episodes of intense UVR > Chronic UVR exposure
↓ Melanoma
↓ Non melanoma skin cancer

UVA
- longer wavelength
- greater depth of tissue penetration
- predominant wavelength used in tanning beds

UVB
- shorter wavelength
- damage to more superficial epidermal layers
- 'SUN BURN'
- natural sunlight

Albinism - ↑ susceptibility to UV radiation

③ Previous melanoma - Risk of developing second melanoma
3 - 7%

④ Family history & Genetic predisposition

- 10% pts have family h/o melanoma
- Family history ↑ melanoma risk 3-8x

- High penetrance susceptibility genes:

CDKN 2A
- Chromosome 9p21
- encodes cyclin dependent Kinase inhibitor 2A p16 INK 4a

25-40% familial melanoma

CDK 4
- Chromosome 12
- encodes cyclin dependent Kinase 4 → important for G1 phase of cell cycle

- Other genes: XP – Xeroderma pigmentosum – defective DNA repair, ↑ UVR sensitivity
  BRCA 2

⑤ Immunosuppression d/t Solid organ transplantation
Hematopoietic cell transplantation
HIV/AIDS

⑥ PRECURSOR LESIONS

- Vast majority of melanocytic nevi → benign
- only ~ 10% melanomas arise in a pre-existing nevus (MOST ARISE DE NOVO)

1) Familial atypical mole melanoma Syndrome / Familial dysplastic Nevus Syndrome / B-K mole syndrome

- Melanoma in ≥1 1°/2° relatives
- Large numbers of melanocytic naevi (>100) → atypical, >5mm
- ± family h/o pancreatic cancer

2) Giant congenital naevi
>20cm size
↑ lifetime risk for melanoma
↑ risk of sarcoma

3) Atypical Spitzoid nevus
- rapidly growing pink/brown benign skin lesion
- → Hard to distinguish from SPITZOID MELANOMA → may need SLNB

Atypical:
>10mm
Asymmetry
Ulceration
poor circumscription

PATHOGENESIS

Gain of function mutations in MAP Kinase pathway
- BRAF
- CDKN 2A (Familial)

Loss of PTEN (25-50% non familial)

70%
No identifiable benign precursor

30%
Benign Melanocytic Nevi
↓
Dysplastic Nevi

PRIMARY MALIGNANT MELANOMA
i
RADIAL GROWTH PHASE

Absent in nodular melanoma

Proliferation of neoplastic melanocytes above dermo-epidermal junction ± Focal Invasion of papillary dermis
Autonomous proliferation ⊕
Aggregative growth ⊖
Lacks metastatic potential

PRIMARY MALIGNANT MELANOMA
i
VERTICAL GROWTH PHASE

- Aggregative growth ⊕
- Extensive dermal invasion
  Expansile nests or nodules of cells

METASTATIC MALIGNANT MELANOMA

Mode of Spread - Usually lymphatic spread precedes hematogenous spread

MELANOMA

Lymphatics

Satellite lesions - skin / subcutaneous lesions within 2cm of primary tumor
- represent intralymphatic extension of the tumor

In-transit lesions - >2cm from the primary tumor but not beyond the regional lymph node basin

→ Regional Nodal Basin

Hematogenous

→ Distant Metastasis - skin, subcutaneous tissue, lungs, liver, brain, other organs

PATHOLOGICAL SUBTYPES OF MALIGNANT MELANOMA

SUPERFICIAL SPREADING MELANOMA

- m/c cutaneous melanoma
- 70% of all melanomas
- m/c in middle age
- 25% a/i preexisting naevus
- Strongly a/i UVR
- Seen on upper back of both genders, legs of females
- Has a radial growth phase before it becomes invasive

Lesions
- Flat
- irregular borders
- pigmentation
- Areas of regression
- Invasion usually heralded by ulceration

HPE
- Uniformly atypical melanocytes
- Pagetoid distribution of melanocytes throughout epidermis

Also called PAGETOID MELANOMA

NODULAR MELANOMA

- 2nd m/c
- 2x more common in ♂
- ~15-30% of all melanomas
- m/c in older age
- Generally arise DE NOVO

POOR PROGNOSIS

weaker UVR association

- Seen on
  - trunk
  - head & neck

Relatively Lacks Radial Growth phase
↓
Early, pronounced VERTICAL GROWTH PHASE

Lesions
- Shorter history
- Better demarcated (d/t relative lack of horizontal spread)
- Papule/nodule usually protuberant
- Ulceration (+)
- Bleeding (+)

HPE

Cohesive aggregates of tumor cells fill the dermis

5% - amelanotic but stain + for tyrosinase

ACRAL LENTIGINOUS MELANOMA

- m/c melanoma in asians & blacks
  ↓
  Darker skin
- median age at Dx 65y

Advanced at the time of diagnosis
- UVR ±

Sites
- Palms
- Soles → m/c
- Subungual region

Radial growth precedes vertical growth

Lesions
- Subungual melanomas → m/c great toe/thumb

Hutchinson sign
- pigmentation of posterior nail fold

HPE
- Prominent acanthosis
- thickened stratum corneum
- Pagetoid spread & intraepidermal nesting

Desmoplasia, neurotropism & angiotropism

LENTIGO MALIGNA MELANOMA

- 4-10%
- sun exposed areas
- 6th - 7th decade

OVERALL - BEST PROGNOSIS

Strongest a/i UVR

Sites:
Face & other sun-exposed areas

Slow growth
- Prolonged radial phase (5-50y)

Lesions
- Large 3-6cm
- tan / brown macules
- slow progression

Invasive counterpart of Lentigo maligna (in-situ melanoma or Hutchinson's Melanotic freckle)

HPE

Melanocytic pleomorphism

DESMOPLASTIC MELANOMA

- ~ 1%
- very rare
- sun exposed areas

60-65y
M > F

may be a/i dysaesthesias & nerve palsies

Sites:
Head and neck

can be AMELANOTIC

Lesions
- Nodular
- Firm
- scar tissue - like

HPE:
Desmoplastic spindling stroma
+
Melanocytic dysplasia
+
↑ Propensity for Perineural invasion
+
Lymphatic spread

CLINICAL FEATURES

1) ABCDE rule of Suspicious pigmented lesions

- (A) Asymmetry
- (B) Border irregularity
- (C) Color variegation - pigment is not uniform
- (D) Diameter >6mm
- (E) Elevated / Evolving / Enlarging lesion - Ulceration / bleeding

2) Satellite nodules & In-transit -mets - erythematous pigmented / amelanotic nodules

3) Symptoms of metastatic disease

EVALUATION

1) Thorough physical examination

2) Dermoscopy
   - Pigment network
     - Regular - Benign
     - Irregular - dysplastic / malignant
     - Broad pigment - early melanoma
   - Pigment
     - Black dots, pseudopods
     - Melanoma - Radial streaming

3) Biopsy
   - Smaller suspicious lesions - Excision biopsy - Full thickness excision (→ upto subcutaneous tissue) ± 1-3mm margin
     - avoid wider margins to permit accurate lymphatic mapping
   - Larger lesions / Lesions on face, palms, soles, ears, distal digits
     - ↓
     - Incisional biopsy - punch / tangential biopsy (→ not preferred)
       - atleast 4mm
       - through the thickest area (NOT EDGE)

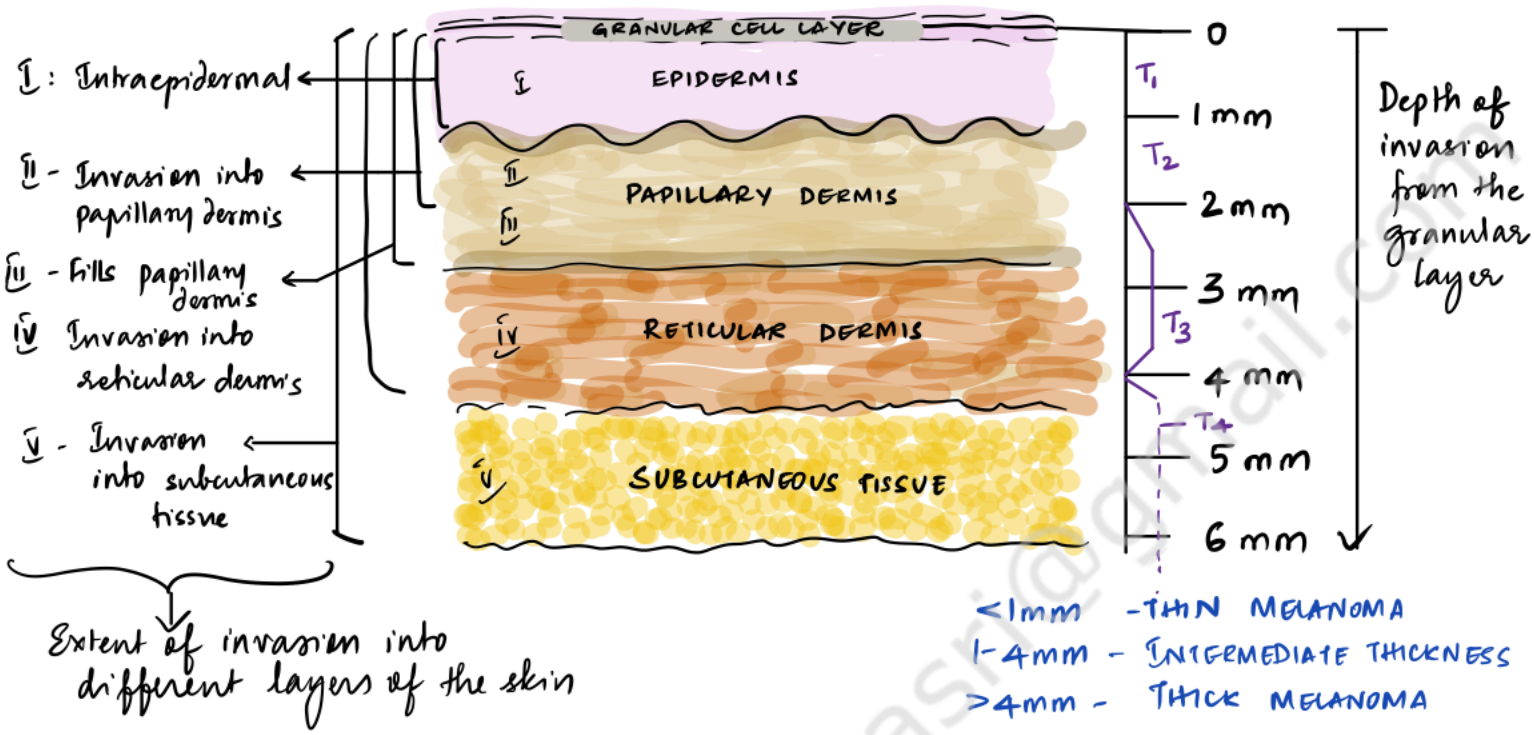
IHC - HMB 45, S-100, Melan A, Vimentin, SOX-10

4) Imaging
   - Nodal basin
     - → USG (Stage I & II)
       - ↓
       - SLNB
     - → Cross sectional imaging
   - Mets - Chest, Abd, Brain - CT / MRI

STAGING

CLARK'S LEVELS (Wallace Clark)

BRESLOW THICKNESS (Alexander Breslow)



AJCC Staging

T0 – No e/o 1°
Tx – cannot be assessed
Tis – Melanoma in situ

T1 (<1mm)
- T1a – < 0.8mm ± ulceration
- T1b – <0.8mm ± ulceration; 0.8-1mm ± ulceration

T2 (1-2mm)
- T2a → ± ulceration
- T2b → ± ulceration

T3 (2-4mm)
- T3a → ± ulceration
- T3b → ± ulceration

T4 (>4mm)
- T4a → ± ulceration
- T4b → ± ulceration

N
- N0 – No nodal mets
- Nx – cannot be assessed

N1
- 1 +ve node or satellite nodule or in-transit metastasis
- N1a – Clinically occult (SLNB+)
- N1b – Clinically +
- N1c – Satellite nodule/ in-transit mets

N2
- 2-3 +ve nodes or satellite nodules or in-transit metastasis
- N2a – Clinically occult (SLNB+)
- N2b – Clinically +
- N2c – Satellite nodule/ in-transit mets + one +ve node

N3
- ≥4 +ve nodes or satellite nodules or in-transit metastasis
- N3a – Clinically occult (SLNB+)
- N3b – Clinically + / Any number of matted nodes
- N3c – Satellite nodule/ in-transit mets + ≥2 +ve nodes

M
- M0 – No distant mets
- M1a – Skin, Soft tissue including muscle, non regional LN
- M1b – Lung mets
- M1c – Non CNS visceral sites
- M1d – CNS mets

(0) → N LDH
(1) → ↑ LDH

Stage Grouping

0 ⟶ Tis N0 M0

I
- Ia - T1a N0 M0
- Ib - T1b / T2a } N0 M0

II
- IIa - T2b / T3a } N0 M0
- IIb - T3b / T4a } N0 M0
- IIc - T4b N0 M0

III ⟶ Any T ≥ N1 M0

IV ⟶ Any T Any N M1

PROGNOSTIC FACTORS

1. Primary lesion:
   - Tumor thickness & Clark levels
   - Ulceration → indicates aggressive biology
   - Mitotic rate
     - ↑ mitotic rates → decreased survival especially in melanomas < 1mm
   - Tumor-infiltrating lymphocytes → host immune response → favorable prognosis
   - Regression
     - Partial / total obliteration of the melanoma due to the host immune response
     - m/c seen in microinvasive / thin melanomas
     - Cytokine mediated, Humeral, Cell mediated
     - seen as focal / partial & rarely, complete regression the tumor
     - uncertain whether it represents a favorable / adverse outcome!

2. Nodal metastasis & Intralymphatic spread

3. Metastatic disease - Non visceral metastasis - better prognosis compared to visceral metastasis
   Elevated LDH - poor prognosis

   Skin, s/c mets - 42-57%; Lungs - 18-36%; Liver - 14-20%, Brain - 12-20%, Bone - 11-17%

4. Other prognostic factors:

   Adverse
   - Advancing age
   - Male gender
   - Axial lesions
   - Vascular / Lymphatic invasion

MANAGEMENT

① PRIMARY CUTANEOUS MELANOMA

Full thickness wide excision → down to the muscle / fascia

Tumor thickness	Recommended Surgical Margin
< 1 mm	1 cm
1 - 2 mm	1-2 cm
2 - 4 mm	2 cm
> 4 mm	2 cm

no evidence that margins >2cm are beneficial; but greater margins may be considered for advanced melanomas when local recurrence risk is high

Melanoma in situ - WLE ± 5mm margin

Mohs Micrographic surgery - used for mainly non melanoma skin cancers
- can be used for thin melanomas / melanoma in situ } in sensitive areas (face)
- Controversial

Subungual melanoma - partial digital amputation ± 1cm margin

② LYMPHNODE MANAGEMENT

SLNB:

Risk of LN metastasis ∝ Melanoma thickness

Status of the sentinel node is the single-most important factor in melanoma patients

Indications for SLNB

- Thick melanomas (>4mm)
- Thin & Intermediate melanomas
  - in the presence of other adverse factors
    - ulceration
    - mitotic rate of >1 mitosis/mm²

Risk of metastasis is higher in >0.75mm

Additional factors
- Clark level 4 / 5
- Pts younger than 40y
- Male gender

SLNB may be considered in solitary, resectable in-transit metastasis

Procedure of SLNB

- Pre-op lymphoscintigraphy - Tc99m sulphur colloid (0.5mCi) injected into dermis ~0.5 cm away from & around the lesion (2-4 hrs before Sx)
  Identification of sentinel nodes ō gamma camera
- Intra-operatively - vital blue dye - isosulfan blue injected in a similar fashion (1-5ml) → 20min → HOT BLUE NODE

SENTINEL NODE : most radioactive node in the nodal basin
any node ≥10% activity as the most radioactive node in the nodal basin
any node that is blue

Elective Lymph Node Dissection (ELND)	Total Lymph Node Dissection (TLND)	Completion Lymph Node Dissection (CLND)
Performed on patients without clinical evidence of nodal metastasis; i.e; in patients ī ont palpable nodes / imaging studies s/o nodal disease	Lymphadenectomy performed for nodal disease detected by palpation / imaging	Lymphadenectomy performed for nodal disease detected by SLNB
no demonstrated survival benefit	Lymphadenectomy is limited to the nodal basin in which the nodes are positive	Lymphadenectomy is limited to the nodal basin in which the nodes are positive
Role - ? Elective ileo-obturator lymphnode dissection among patients ī tve inguinofemoral nodes (≥3 / Cloquet node +) without clinical evidence of ileo-obturator (pelvic node involvement)	Eg: Axillary dissection, Neck dissection, Inguinofemoral dissection → Superficial, Deep; Ilio-obturator / pelvic dissection	Eg: Axillary dissection, Neck dissection, Inguinofemoral dissection → Superficial, Deep; Ilio-obturator / pelvic dissection
CONTROVERSIAL		

Complications of Lymph node dissection

1) Delayed wound healing
2) Wound infection
3) Seroma
4) Lymphedema

Management of in-transit metastasis

In the absence of disseminated disease

- Resectable → Resection with curative intent
- Unresectable → Isolated limb perfusion
- Unresectable → Treat like metastatic disease

ISOLATED LIMB PERFUSION

HILP - Hyperthermic Isolated Limb Perfusion

- improves the cytotoxicity of the chemotherapeutic agent
- Can administer higher doses of cytotoxic agent while avoiding systemic toxicity

Formal lymphnode dissection
↓
Exposure to the vessels
↓
Cannulation
↓
Extremity is placed on extracorporeal (Oxygenated) bypass circuit after application of tourniquet
(Isolation of the limb from systemic circulation)
↓
Administration of chemotherapeutic agent → Melphalan ± Actinomycin D/TNFα

ISOLATED LIMB INFUSION

Simpler and less invasive compared to ILP

- Performed percutaneously under radiological guidance (i.e., no LND)
- No oxygenated circuit

→ through the main artery/vein of unaffected limb → affected limb
↓
Pneumatic tourniquet
Infusion of cytotoxic agent & 'hand-circulation' using syringes for 20-30mins
→ Progressive hypoxia, acidosis } improves cytotoxicity of Melphalan

MULTIMODALITY

(1) RADIATION THERAPY: → Melanoma is relatively radioresistant

EBRT < IMRT / IGRT

a) RT to regional nodal basin → 50-60 Gy
- +ve nodes - ≥1 parotid, ≥2 cervical/axillary, ≥3 inguinofemoral
- Bulky disease - lymphnodes ≥3cm cervical/axillary, ≥4cm inguino femoral
- Extranodal soft tissue extension

b) RT to 1° site - in high risk of local recurrence in SELECT cases → 60-66 Gy
- in +ve/close surgical margins when re-resection is not feasible
- location in head & neck
- Extensive neurotropism
- Pure desmoplastic melanoma
- Locally recurrent disease

c) Definitive Radiotherapy → 60-70 Gy
↓
For in situ melanoma - Lentigo maligna
in medically inoperable patients

d) RT for intransit disease - ± definitive/palliative intent
optimal doses not established

e) RT for distant mets
- Brain mets - Stereotactic Radiotherapy/Stereotactic Radiosurgery
- Whole brain Radiotherapy
- For extracranial met - Stereotactic Body RT

SYSTEMIC THERAPY IN MELANOMA

IMMUNOTHERAPY

ADJUVANT

- in pts ↑ with tve LNs
- 1° >4mm ↑ont ulceration
  >2mm ↑ ulceration

1) INFα-2b
2) Pegylated INFα-2b
3) Ipilimumab (CTLA-4 blocking antibody)

METASTATIC MELANOMA

1) PD-1 blocking ab
   PEMBROLIZUMAB
   NIVOLUMAB
2) CTLA-4 ab
   IPILIMUMAB
3) TALIMOGENE LAHERPAREPVEC (intralesional)
4) IL-2

TARGETED THERAPY

1) BRAF inhibitors
   DABRAFENIB
   VEMURAFENIB
2) MEK inhibitors
   TRAMETINIB
   COBIMETINIB
3) BRAF + MEK inhibitors
4) Kit inhibitors
   imantinib

CHEMOTHERAPY

- For metastatic Melanoma in patients who progressed on immunotherapy / targeted therapy

- DACARBAZINE
- TEMEZOLAMIDE (oral analog of dacarbazine)
- Nab Paclitaxel
- Other agents
  Platins
  Nitrosoureas
  Vinca alkaloids
  taxanes

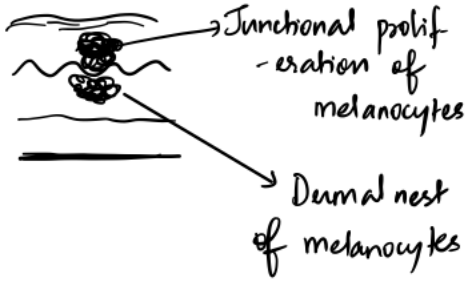
NEVI

Intradermal naevus

- Nevus of Ota
- Blue nevus
- Spitz nevus
- Halo nevus

Junctional nevus

Compound nevus



Non cutaneous melanoma

① Ocular melanoma – Enucleation
I-125 Brachytherapy
Photocoagulation
Partial resection

Lack of lymphatic vessels in uveal tract → No lymphatic spread

Hematogenous spread - driver

② Mucosal melanomas
H&N - Oral cavity, Oropharynx, Nasopharynx, PNS
Anorectum, female genitalia

GRAFTS

Grafts are tissues that are transferred without their blood supply & therefore have to revascularise once they are in a new site.

A skin graft is a segment of epidermis & dermis ± subcutaneous / other tissue that is separated from its blood supply and donor site and transplanted to another recepient site on the body

TYPES OF SKIN GRAFTS

Based on Source

1) AUTOGRAFT: harvested from the same individual
2) ALLOGRAFT: harvested from another individual
   - HOMOGRAFT: of same species
   - HETEROGRAFT: of different species (Xenograft)

Based on Composition / Thickness

PARTIAL THICKNESS
- SPLIT THICKNESS SKIN GRAFT
- THIERSCH GRAFT

Consists of epidermis & variable amount of dermis

can be harvested from anywhere: thighs, abdomen, buttock, scalp

Donor site considerations
- color & texture
- thickness of skin required
- scar visibility

Harvested using a dermatome (HUMBY, WATSON)
- Donor site heals by regeneration from dermal and epidermal elements remaining after harvest

typically dry, requires emollients

0.006 – 0.028 inch thick

FULL THICKNESS
- WOLFE GRAFT

Epidermis + Complete Dermis ± portions of sweat glands, sebaceous glands, hair follicles

Harvested from areas where skin is thin - Upper eyelids, post auricular crease, supraclavicular area, Hairless groin, Elbow crease
- Generally harvested with a Knife
- Area of harvested graft is small as the donor site is usually closed by primary sutures

contains skin appendages - can grow hair & secrete sebum

COMPOSITE

contains skin + subcutaneous tissue + Cartilage etc

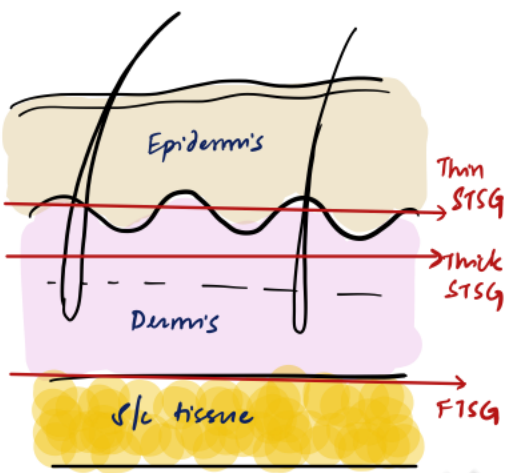
↓

used in places where extra tissue bulk / function is required.

Eg: Harvesting auricular skin & cartilage to reconstruct nasal defects

↓

particularly alar reconstruction



MESHING

Multiple fenestrations made manually / ± a mesher to increase surface area of the split thickness skin graft

Useful when there is paucity of donor skin available
- recepient bed is bumpy / convoluted
- recepient bed is suboptimal (exudate)

Meshing ratios: 1 : 1.5 to 1 : 6

Disadvantages - 'pebbled' appearance - aesthetically poor

Other techniques to optimize graft area
- Micrografts
- Fractional skin harvesting

	THIN STSG	THICK STSG	FTSG
Dermal Content	+	++	+++
Primary contraction - contraction of graft tissue immediately after harvest d/t presence of dermal extracellular matrix such as ELASTIC FIBRES	↓↓ - due to presence of fewer elements of dermal ECM	+	+++
Secondary contraction - contraction of the receipient bed after graft placement (6d-10m) → d/t myofibroblasts in bed	+++	++	↓
Engraftment	+++ Better, due lower metabolic demands	++	+
Durability	+	++	+++
Pigmentation	+++	++	+
Resistance to dessicaton	+	++	+++
Appearance	+	++	+++

Survival of the graft requires a vascularised wound receipient bed : adequate blood supply

Healthy soft tissue
Periosteum
Perichondrium
Paratenon
Perforated bone surface which allows granulation

Poor graft surfaces with inadequate blood supply
- exposed bone / cartilage
- tendon
- fibrotic chronic granulation tissue
- irradiated sites

ENGRAFTMENT / GRAFT 'TAKE'

① ADHERENCE
- During first 24-48 hrs after placing graft
- Graft is held in place by thin film of FIBRIN

② PLASMATIC IMBIBITION
- Cellular elements survive by diffusion of O_2 & substrate from plasma present in open wound

③ INOSCULATION
- fine vascular network forms from capillaries in the wound bed - advances through fibrin layer towards cuts ends of vessels on the deep surface of dermis
↓
loose anastomoses
↓
O_2 & nutrient transfer

STAGE OF MAX GRAFT VULNERABILITY

④ REVASCULARISATION
Firmer vascular anastomoses → vessels heal
→ Graft is perfused by wound bed 4-7 days

⑤ REMODELLING / GRAFT MATURATION
Fibroblasts replace fibrin layer - D_7
Reinnervation - begins ~ 4-5 weeks
completed by ~ 12-24 months

CAUSES FOR GRAFT FAILURE

1) Hematoma / Seroma → m/c/c for graft failure
2) Shear → precludes revascularisation
3) Infection
4) Unsuitable recepient site

Reharvesting from the donor site is possible after a period of healing
Donor site epidermis regenerates from the immigration of epidermal cells originating in the hair follicle shafts and adnexal structures left in the dermis.

THE DERMIS NEVER REGENERATES

∴ The number of SSGs harvested from a donor site ∝ donor dermis thickness

OTHER GRAFTS

Nerve grafts - usually taken from sural nerve

Tendon grafts - Palmaris longus
Plantaris

FLAPS

Flaps are tissues that are transferred from the donor site to the recepient site along with their blood supply.

Usually employed while - covering recepient beds i poor vascularity (Grafts won't work)

- covering vital structures / reconstructing face & functionally & aesthetically sensitive areas

'REPLACE LIKE i LIKE'

TYPES OF FLAPS

BASED ON COMPOSITION

(tissue contained in the flap)

1) CUTANEOUS FLAP
   contains skin
2) FASCIOCUTANEOUS FLAP
   contains deep fascia & skin
3) MUSCULOCUTANEOUS FLAP
   contains muscle & skin
4) OSSEOCUTANEOUS FLAP
   contains bone & skin ± other tissue
   → (COMPOSITE FLAPS)
5) INNERVATED / SENSATE FLAP
   carries sensory nerve supply
6) VISCERAL FLAP

BASED ON FLAP 'MOVEMENT'

LOCAL TRANSFER

1) ROTATION FLAP (PIVOT)
2) TRANSPOSITION FLAP
   Eg: Limberg / Rhomboid
   Bilobed flap
   Z-plasty
3) INTERPOLATION
4) ADVANCEMENT FLAP
   V-Y / Y-V Plasties
   Rectangular Advancement Flaps (i Burrow Δs)

DISTANT TRANSFER

1) PEDICLED FLAP
   DIRECT FLAP
   Groin flap for hand defect
   TUBE FLAP
   DP flap
2) FREE FLAP
   Microvascular transfer
   Eg: Radial free forearm flap

BASED ON BLOOD SUPPLY

1) Random flap
   incorporation of vascularity occurs on a random basis
   Eg: Most local flaps
2) Axial flap - main bed supply of the flap runs axially within the flap

BASED ON THE PLANE IN WHICH THE VESSELS RUN

1. DIRECT CUTANEOUS FLAP
2. FASCIOCUTANEOUS FLAP
3. SEPTOCUTANEOUS FLAP
4. MUSCULOCUTANEOUS FLAP

Special types - Prefabricated flaps
Prelaminated flaps

LOCAL FLAPS

Flaps Rotating about a PIVOT POINT

→ Rotation flap
→ Transposition flap
- Rectangular
- Bilobed
- Limberg flap
- Z-plasty

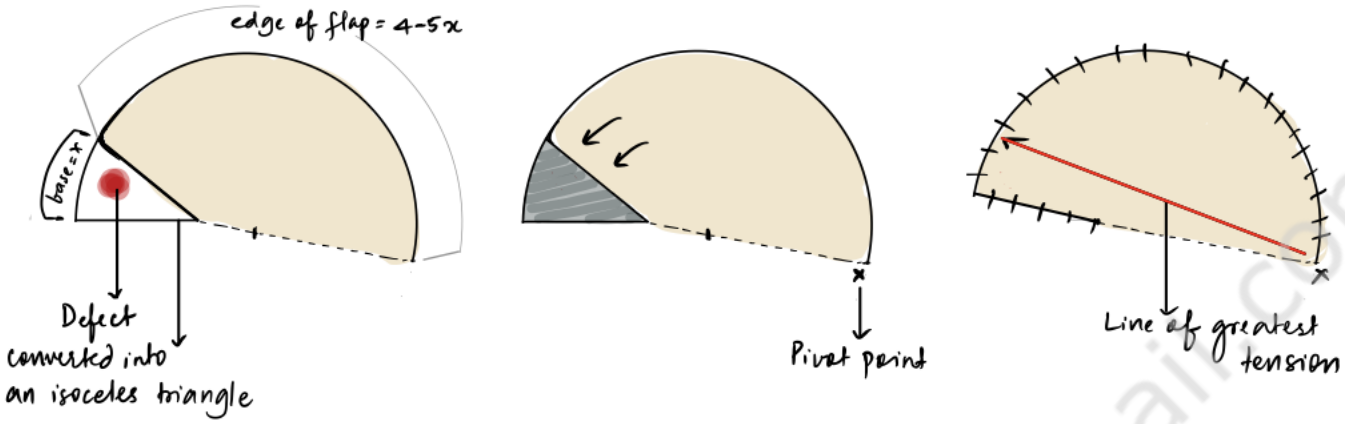
→ Interpolation flap

Advancement flaps

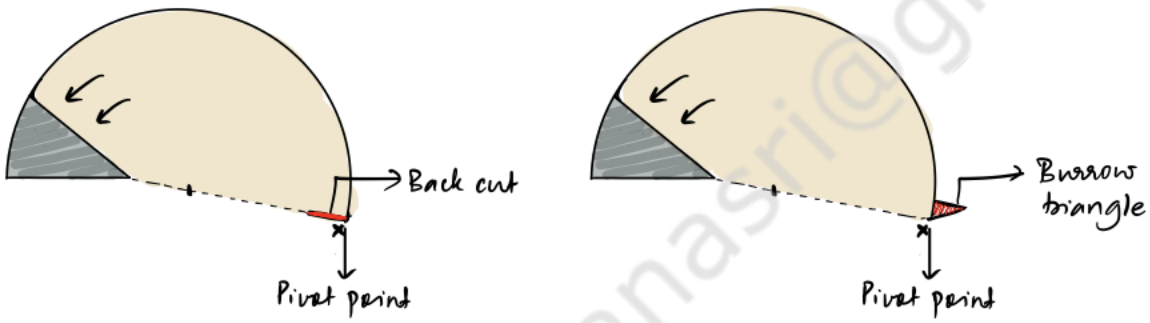
→ Rectangular
→ V-Y advancement flaps
→ Y-V advancement flaps

① ROTATION FLAP

semicircular flap that rotates about a pivot point through an arc of rotation into an adjacent defect



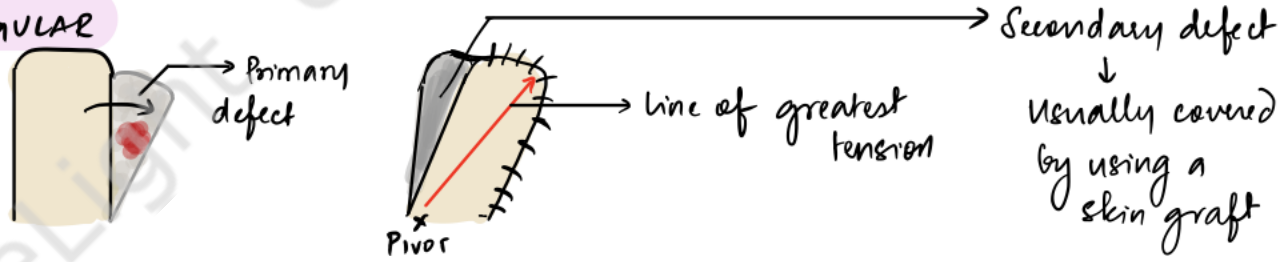
METHODS TO REDUCE TENSION IN ROTATION FLAPS



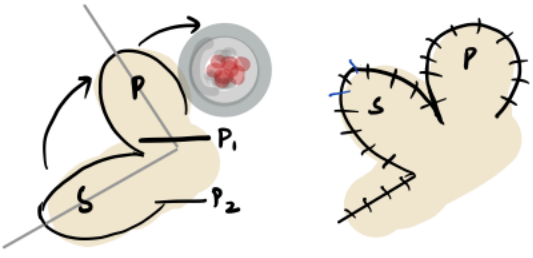
② TRANSPOSITION FLAP

tissue rotated about a pivot point into an immediately adjacent defect

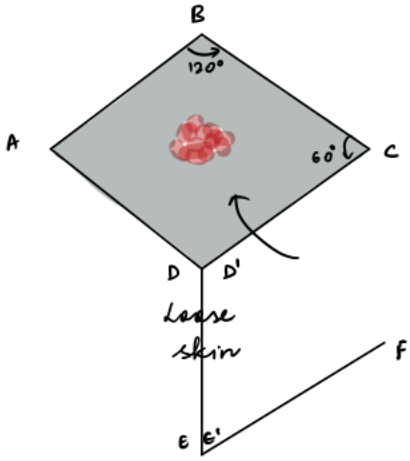
- RECTANGULAR

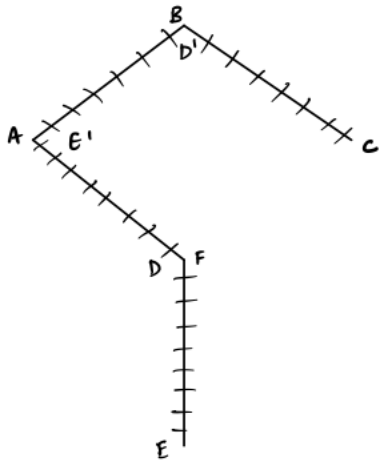


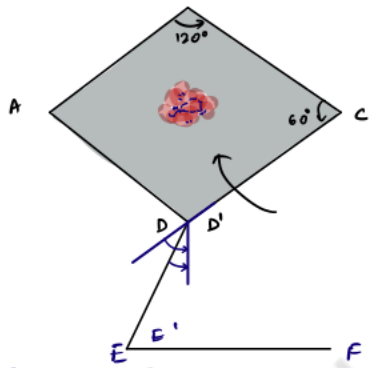
- BILOBED FLAP – After lesion is excised, primary flap (P) is transposed into the initial defect. The secondary flap (S) is then transposed into the defect left by the primary flap.



• LIMBERG FLAP - Transposition flap for rhomboid defects

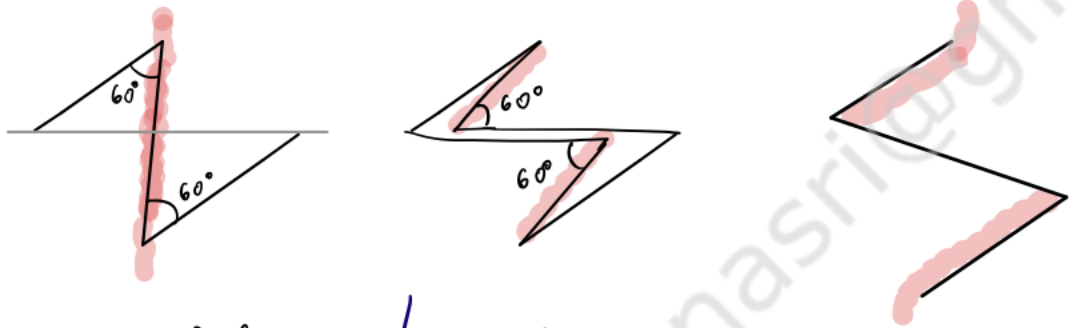






DUFOURMENTAL MODIFICATION OF LIMBERG FLAP

Z- PLASTY

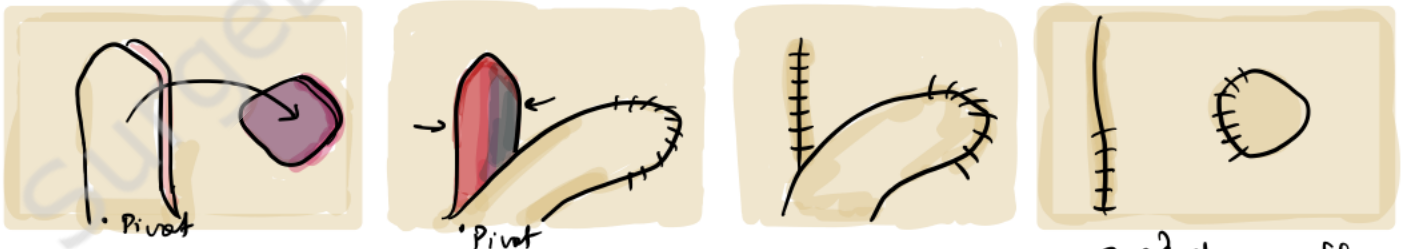


Generally used for scar / tissue lengthening

W- PLASTY - for scar revision

(3) INTERPOLATION FLAP

- Rotates about a pivot point into a NEARBY, but NOT ADJACENT defect
- Base of the flap is located at some distance from the defect
- Pedicle passes OVER / BENEATH an INTACT skin bridge
- Flap is subsequently detached in a second surgical procedure



2nd stage - flap division

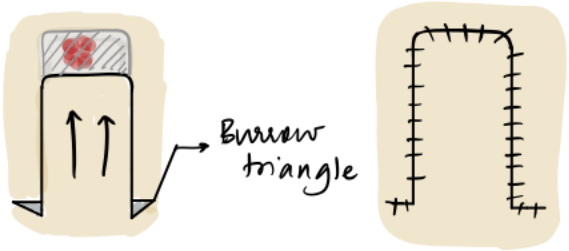
Eg: Median forehead flap
Nasolabial flap

Can be considered to be a type of transposition flap

(4) ADVANCEMENT FLAP

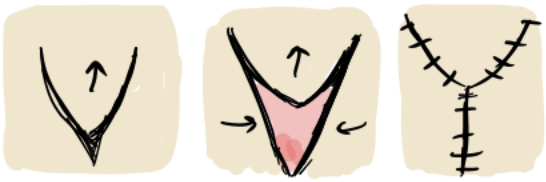
Flap moves directly forward into a defect without any rotation/lateral movement

1. RECTANGULAR ADVANCEMENT FLAP - single pedicle flap which is stretched forward taking advantage of the elasticity of the skin



2. V-Y ADVANCEMENT FLAP

Forward advancement of a triangular flap (V) and closure of resulting defect in a Y fashion



Applications
- Lengthening of nasal columella
- Correcting cohistle deformity of lip
- Closure of soft tissue defects such as finger tip defects

3. Y-V ADVANCEMENT FLAP - Excision of a Y-shaped area and closure in the form of a 'V'

Applications
Anal advancement flap to prevent anal stenosis in fissure surgery

---

DISTANT FLAPS

PEDICLED FLAPS

transferred to a distant recepient area while still attached to their native area via their vascular pedicle

TYPES

DIRECT
- flap directly approximated to recepient site

TUBED
- lateral edges of the flap sutured together to form a tube

Pedicled flaps are limited by the **ARC OF ROTATION**

FREE FLAPS

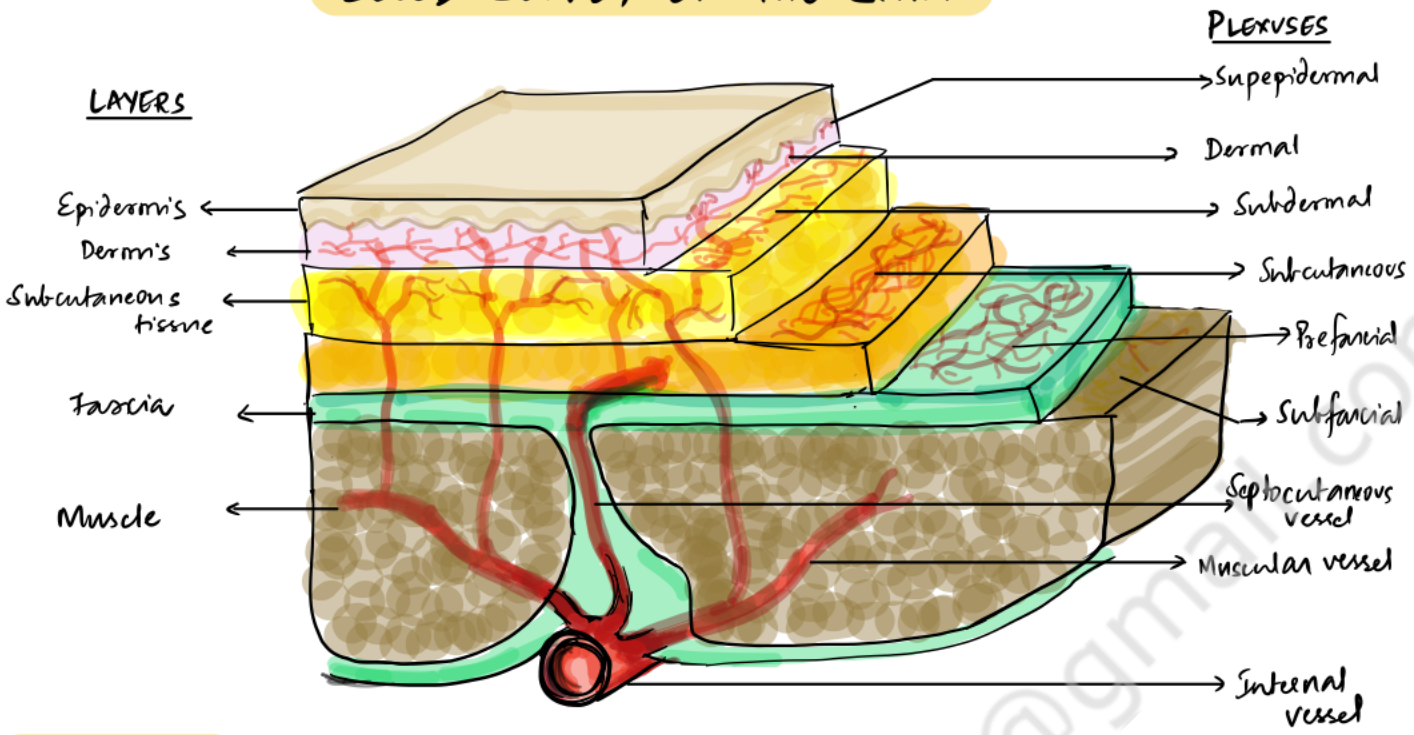
detached from the native area & the flap vessels are anastomosed with the vessels at the recepient area

↓

Made possible by principles of

VASCULAR ANASTOMOSIS

BLOOD SUPPLY OF THE SKIN



ANGIOSOMES - Discrete blocks of tissue supplied by one vascular unit (considerable overlap)

CHOKE VESSELS - small vessels of dynamic caliber between adjacent angiosomes)

TYPES OF FLAPS BASED ON BLOOD SUPPLY

DIRECT CUTANEOUS FLAP	FASCIOCUTANEOUS FLAP	SEPTOCUTANEOUS FLAP	MUSCULOCUTANEOUS
The horizontal cutaneous vessels supplying the flap travel in the LOOSE CONNECTIVE TISSUE RATHER THAN IN THE DEEP FASCIA	The horizontal cutaneous vessels lie on the DEEP FASCIA	Perforators come from subfascial source vessel and course ALONG INTERMUSCULAR SEPTAE	Perforators arise as INDIRECT BRANCHES from the MUSCULAR BRANCHES of the source vessel
There is usually soft tissue laxity	Fascial layer is usually included in the flap to make vascularity more reliable	Eg: LATERAL ARM FLAP	(Indirect perforators)
AXIAL CUTANEOUS ARTERIES are seen in GROIN SCAPULAR AREA	vessels usually accompanied by nerves	(In-transit perforators)	Eg: GLUTEAL AREA
	Eg: SCALP, LIMBS		

very versatile & commonly used flaps

Perforators

- Direct → Perforate the fascia & supply skin directly
- Indirect → Source-vessel gives off a branch to a muscle which then, in turn, gives off branches which perforate fascia to supply skin

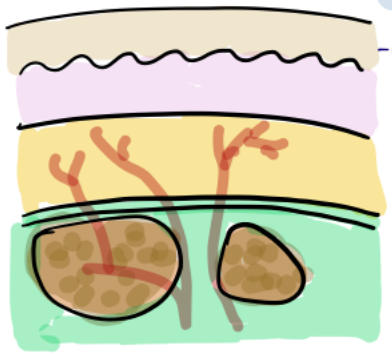
(Ref Fig 68-2 on pg 1941, Sabiston 20ed)

FASCIOCUTANEOUS FLAPS – PERFORATOR FLAPS

(Based on blood supply)

TYPES

CORMACK & LAMBERTY CLASSIFICATION

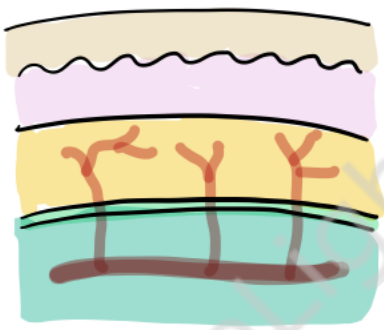


TYPE - A

- Multiple Perforators without any specific type of origin
- Perforators may be direct / indirect

TYPE - B

- Single Perforator (usually direct)



TYPE - C

- Segmental Perforators
  - ↓
  - Multiple, arising periodically from the same underlying source vessel

MATHES & NAHAI CLASSIFICATION

TYPE - A

Direct cutaneous

- Source vessel runs axially in subcutaneous tissue

Eg: Temporoparietal flap based on Superficial temporal vessels
. Groin flap based on Sup circumflex / Inf ep

TYPE - B

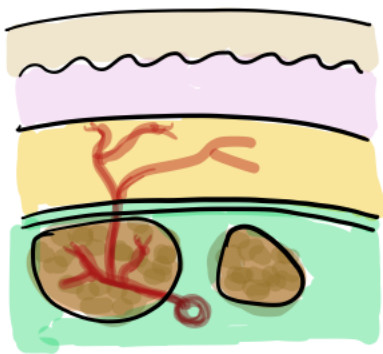
Septocutaneous perforator (Direct)

Radial forearm flap

TYPE - C

Musculocutaneous perforator (Indirect)

Peroneal flap



'Retention of the muscle is no longer considered mandatory to ensure the survival of the cutaneous component.

Here, the term 'musculocutaneous' refers to the nature of the perforator supplying the fasciocutaneous flap, NOT composition of the flap.

PERFORATOR FLAPS require neither a passive muscle carrier nor the underlying fascial plexus to survive provided the MUSCULO / SEPTOCUTANEOUS vessel is preserved

- Allow preservation of functional muscle & fascia at donor site
- Versatility of flap design (can control flap bulk)

MUSCLE FLAPS/MYOCUTANEOUS FLAPS

Blood supply of muscles (Pedicles)
- Dominant - can independently sustain the entire muscle
- Minor - can maintain only a portion of the given muscle
- Segmental - nourishes a small segment of the muscle

MATHES & NAHAI CLASSIFICATION OF BLOOD SUPPLY OF MUSCLES

TYPE - 1
SINGLE DOMINANT PEDICLE

Most reliable as the entire muscle will survive if the dominant pedicle is secured

Eg: GASTROCNEMIUS
- Sural artery

Tensor fascia lata
- lateral circumflex femoral A (asc. br)

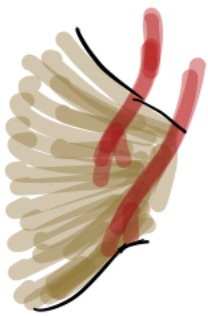
TYPE - 2
DOMINANT PEDICLE(S) + MINOR PEDICLES

Eg: Gracilis
- Medial circumflex femoral

Trapezius
- Transverse cervical

Can utilize 'Delay phenomenon

TYPE - 3
TWO DOMINANT PEDICLES



Eg: Gluteus maximus
- Superior + Inf gluteal

RECTUS ABDOMINIS (TRAM Flap)
- Superior + Inferior epigastric

Serratus anterior

TYPE - 4
SEGMENTAL SUPPLY

Eg:
Sartorius
Tibialis Anterior

(Least useful)

TYPE - 5
1 DOMINANT PEDICLE + SEGMENTAL VESSELS

Eg:
Latissimus dorsi
- THORACODORSAL A
- Posterior intercostal As
- Lumbar As

Pectoralis major
- THORACOACROMIAL
- Lateral thoracic A
- branches of internal mammary A

Reverse flap: when a muscle flap is elevated on its secondary pedicle, after division of the dominant pedicle
Eg: Raising P. major flap based on internal mammary branches (after dividing thoracoacromial vessels) to cover sternal defect

'DELAY' PHENOMENON - a strategy used to extend the restricted size of flaps
- usually achieved by interrupting a portion of the blood supply (dividing non-dominant / co-dominant pedicles) to the flap without transferring the flap from its native position

↓ 1 - 3 weeks

↓ Sublethal ischemia

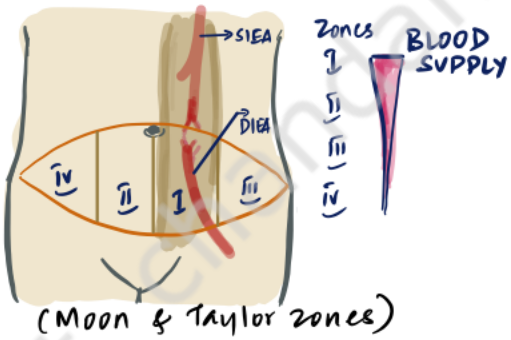
↓

1) Opening of 'choke' vessels (which are normally closed) allowing blood flow to the ischemic region
2) Re-orientation of vessels within the flap into a more longitudinal pattern
3) Angiogenesis within the flap

↓

Improves flap survival esp in
- Diabetics
- Smokers

IMPORTANT FLAPS AND THEIR APPLICATIONS

FLAP	SOURCE VESSELS	USES
LATISSIMUS DORSI FLAP (Type V muscle flap)	Thoracodorsal vessels TDA - continuation of subscapular A (Br. of AA_3)	As islanded pedicled flap Reconstruction of - BREAST, CHEST WALL - SHOULDER, BACK, NECK As free flap - reconstruction of SCALP & LOWER LIMB DEFECTS
PECTORALIS MAJOR FLAP (Type V muscle flap)	- THORACOACROMIAL TRUNK (also, lateral thoracic)	WORKHORSE FLAP FOR HEAD AND NECK RECONSTRUCTION
DELTOPECTORAL FLAP Composed of skin, subcutaneous tissue & fascia (NO MUSCLE)	Upper 3-4 perforating branches of the INTERNAL MAMMARY A	Alternative to PMMC for maxilla & mandible reconstruction
RECTUS ABDOMINIS FLAP (Type III Muscle) [pg 870 - section on Breast recon in Sabiston 20ed]	SUPERIOR EPIGASTRIC VESSELS → Pedicled TRAM flap INFERIOR EPIGASTRIC VESSELS → Free TRAM flap (DEEP INF. EPI. VESSELS ⟷ THORACODORSAL VESSELS)  (Moon & Taylor zones)	msTRAM - muscle sparing TRAM flap ↳ only muscle fibres around the pedicle are included in the FLAP Perforator flaps → no muscle is taken • DIEP > • SIEA BREAST RECON, Limb/groin recon
GLUTEAL FLAP	SUPERIOR GLUTEAL ARTERY INFERIOR GLUTEAL ARTERY	Myocutaneous / Perforator flaps Reconstruction of Breast Sacral pressure sores
GROIN FLAP (Axial pattern flap)	SUPERFICIAL CIRCUMFLEX ILIAC	Free / Pedicled Head & neck / chest / extremities RECON
RADIAL FOREARM FLAP (Fasciocutaneous) Can also contain Palmaris longus & Bone	RADIAL ARTERY ± paired venae comitantes ± Cephalic vein	Free / Pedicled - Recon of Floor of mouth / cheek / lips Tongue Orbit
ANTEROLATERAL THIGH FLAP (Perforator flap)	LATERAL CIRCUMFLEX FEMORAL A (Descending branch)	Fasciocutaneous flap / flap ± Vastus lateralis Head & neck, extremity reconstruction

TENSOR FASCIA LATA	LATERAL CIRCUMFLEX FEMORAL A (Ascending branch)	Pressure sore reconstruction Facial reanimation Head and neck reconstruction
GRACILIS	MEDIAL CIRCUMFLEX FEMORAL A	Head & neck, extremity reconstruction Facial reanimation Restoration of anogenital sphincter function
GASTROCNEMIUS	MEDIAL OR LATERAL SURAL	Knee cover after arthroplasty
SOLEUS	POPLITEAL/ POSTERIOR TIBIAL OR PERONEAL	lower limb reconstruction
TRAPEZIUS	TRANSVERSE CERVICAL	Head and neck reconstruction

Keloids and hypertrophic scars are proliferative scars characterized by excessive net collagen deposition

KELOID	vs	HYPERTROPHIC SCAR
Rare		more frequent
predilection for African American, Asian and Hispanic ethnicities		No identified ethnic predilection
Sites: neck, chest, earlobe, shoulders, upper back		Anywhere
Autosomal dominant inheritance ; incomplete penetrance		No
Timing - Usually, there is a symptom free interval after the trauma (Surgery / burns / skin lesions, injections, insect bites, body piercings) → 3 months - years		Usually appear within 4-6 of the injury
• raised above skin level • extends beyond wound margins		• raised above skin level • does not extend beyond wound margins
• a/i pain, ↑ pruritus, hyperesthesia		• Pruritus ±
• usually does not regress		• Frequently regresses spontaneously
HISTOLOGICALLY - Collagen (I & III) fibres are scattered in a disorganised manner		↑ Type III Collagen fibres arranged in random bundles ; fibres in wavy pattern
Fibroblasts in keloids deposit collagen fibres at a rate 20× ↑ than (N) 3× ↑ than HTS		↑ TGF β expression ↑ sensitivity to TGF β
Abnormal amount of extracellular matrix - Fibronectin, elastin, proteoglycans		- Generally result from tension at the wound edges
NOT PREVENTABLE		PREVENTABLE
• Contracture - rare		• Contracture - frequent

TREATMENT OF KELOIDS & HYPERTROPHIC SCARS

Prevention

- Post-surgery preventive silicone sheeting
- Post-surgical scar site corticosteroid injection
- Post-surgical topical imiquimod
- Post-surgical Fluorouracil, triamcinolone & pulsed dye laser

First line Rx

- Cryotherapy
- Intralesional steroid (Q6wk)
- Combined Cryotherapy + Intralesional steroid
- Silicone elastomer sheeting
- Surgical excision - Perilesional → ↑↑ recurrence rate
- Pulsed dye laser

Second line Rx

- Verapamil 2.5mg/mL - intralesional inj
- Fluorouracil 50mg/mL - intralesional inj
- Bleomycin tattooing
- Post-surgical INFα
- RT
- Post excision RT
- Onion extract topical gels

Z-plasty / Contracture release } in hypertrophic scars
De-epithelisation & SSG
Flap

TISSUE EXPANSION

- technique that uses a mechanical stimulus to induce tissue growth so as to generate soft tissue for reconstruction

- involves placing a prosthesis
  ↓
  gradually enlarged by the addition of saline
  ↓
  ↑ in surface area of overlying soft tissue
  ↓
Initially - stretching - interstitial fluid is forced out, elastic fibres fragmented
visco-elastic changes in collagen
↓ Hb
Actual growth of skin flap: ↑ surface area, ↑ collagen & matrix
Epidermal thickening
Dermal thinning
Subcutaneous fat atrophy
unaffected skin appendages

MECHANICAL CREEP
BIOLOGICAL CREEP
STRESS RELAXATION

PREREQUISITES FOR SITE OF TISSUE-EXPANDER PLACEMENT

- Tissue undergoing expansion must have capacity for growth
  affected by prior irradiation and scar
- Expanders perform poorly under skin grafts, very tight tissue & in hands & feet
- Should not be placed in the vicinity of - Malignant neoplasm
  Hemangioma
  Open leg wound
- Should be placed under the tissue that best matches the lost tissue
- Normal landmarks such as eyebrows / hairline should not be distorted

---

Incision is placed at the edge of the expander - incision to harvest the expanded tissue should be along the same
- Filling of expander - initiated 2 weeks after insertion
  done 1/2 times / week

UTILITIES

- Abdominal wall reconstruction
- Breast reconstruction
- Reconstruction of scalp defects
- Large cutaneous lesions like melanocytic nevi/scars
- Forehead expansion for nasal reconstruction
- Prelaminated flaps
- Expansion of FTSG donor sites

ADVANTAGES

- Pre-expansion of transposition / rotation flaps - ↑ amount of tissue, enhances flap vascularity & ↓ donor site morbidity
- can provide matching tissue for reconstruction
- Normal sensibility of transfered tissue
- Negligible donor defect

LIMITATIONS

- Can't be used for reconstruction of oncological defects d/t unacceptable delay
- Pre-expanded free-flaps - challenging - d/t distortion of vascular pedicle

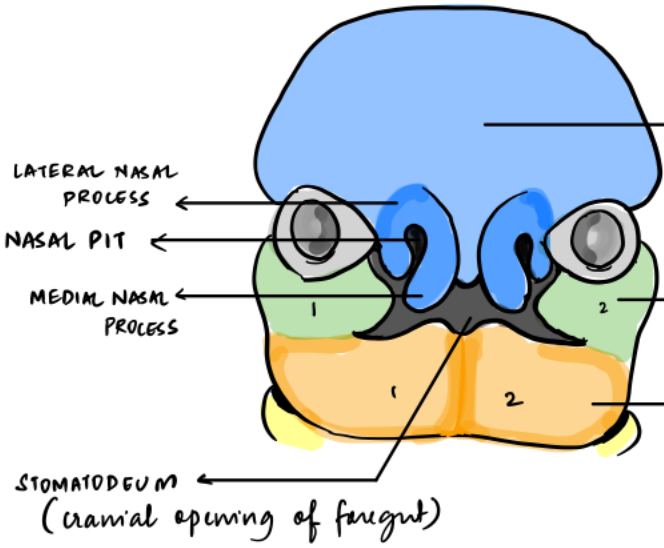
CLEFT-LIP & CLEFT-PALATE

EMBRYOLOGY AND ANATOMY

DEVELOPMENT OF FACE - MAXILLOFACIAL FRAME

- 4 weeks - 8 weeks

Fusion of the five facial elements occurs well within I trimester



1 FRONTONASAL PROMINENCE
(formed by mesechyme ventral to forebrain)

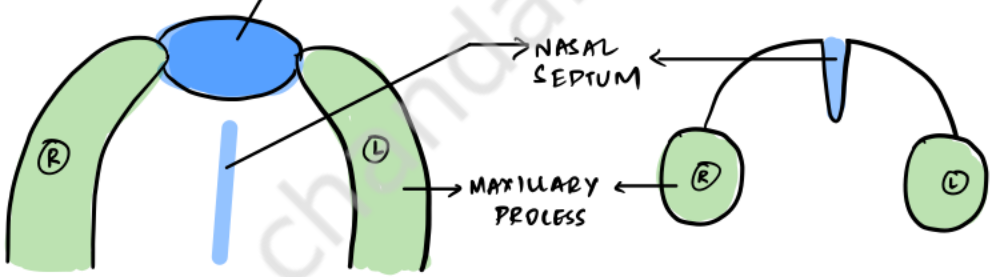
2 MAXILLARY PROMINENCES

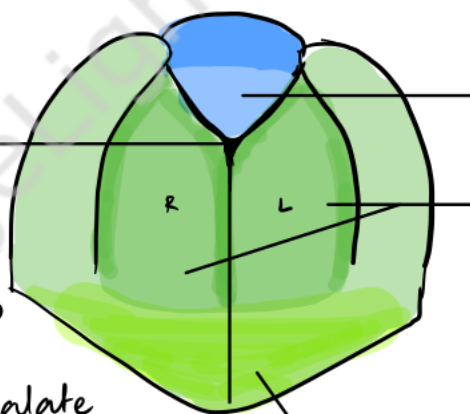
2 MANDIBULAR PROMINENCES

Produced by neural crest cells that migrate from the 1st branchial arch

5 facial elements

DEVELOPMENT OF PALATE → 6-10 weeks





INCISIVE FORAMEN → At the junction of primary & secondary palate

MEDIAN PALATINE PROCESS → FORMS PRIMARY PALATE
- Lip, alveolus
- Hard palate anterior to incisive foramen

LATERAL PALATINE PROCESSES → FORM SECONDARY PALATE
- Hard palate posterior to incisive foramen
- Soft palate

Nasal septum / Vomer

POSTERIOR PORTION OF SECONDARY PALATE DOES NOT UNDERGO MEMBRANOUS OSSIFICATION → SOFT PALATE

CLEFT LIP - Partial / complete lack of circumferential continuity of the lip due to a congenital defect in lip fusion (2)

The most common mechanism of cleft lip is failure of fusion between MAXILLARY PROMINENCE and the MEDIAL NASAL PROCESS on the affected side

→ can range from small notches in the vermillian
to
extension through nostril & maxilla

CLEFT PALATE:

results from incomplete / absent fusion of the lateral palatine processes, median palatine process, or nasal septum

ETIOLOGY of Cleft lip & Cleft palate

- Pierre Robin Sequence
- Genetics - Familial predisposition - 1° relative - incidence ↑ to 1:25 live births
- Viral infections during 1st trimester - Rubella
- Protein & vitamin deficiencies in early pregnancy
- Chromosomal abnormalities
  - Trisomy 13 (Patau s°)
  - Trisomy 21 (Down s°)
- Maternal epilepsy & drugs

Epidemiology

Cleft Lip + Palate ⟶ m/c ~ 50%.
Cleft palate alone ⟶ 30%.
Cleft lip alone ⟶ 20%.

Syndromes a/i Cleft lip & palate

1) Stickler Syndrome
2) Shprintzen Syndrome
3) Down's Syndrome
4) Apert Syndrome
5) Treacher Collins Syndrome
6) Klippel Feil Syndrome

PIERRE ROBIN SEQUENCE

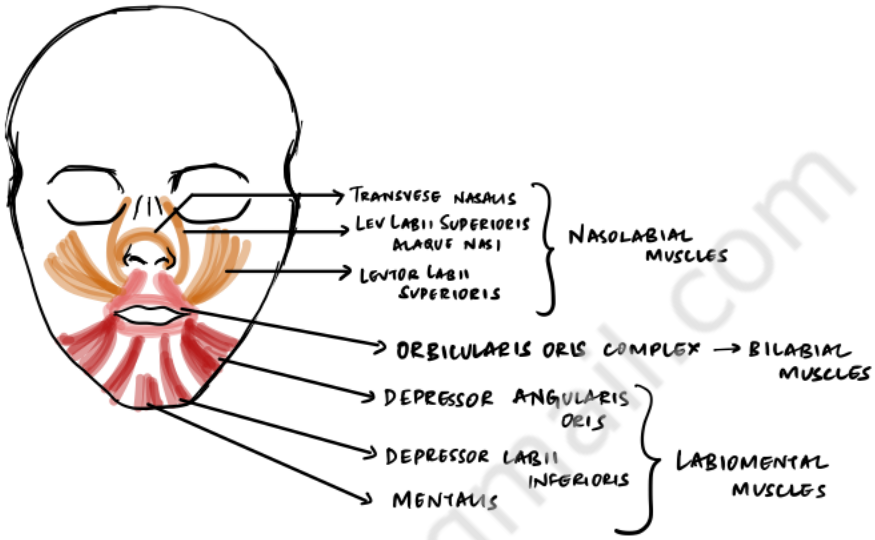
- Cleft palate
- Retrognathia
- Glossoptosis

CLEFT LIP

Facial Muscular anatomy

3 Muscular Rings of DELAIRE

1. NASOLABIAL RING
   - surrounds nasal aperture
2. BILABIAL RING
   - surrounds oral aperture
3. LABIOMENTAL Ring
   - surrounds lower lip & chin



CLEFT LIP - TYPES

Unilateral | Median | Bilateral

Unilateral disruption of nasolabial & bilabial rings

CLEFT LIP - DEGREES

MICROFORM | INCOMPLETE | COMPLETE

SMALL NOTCH IN THE VERMILION

CLEFT WHICH SPARES THE NASAL SILL

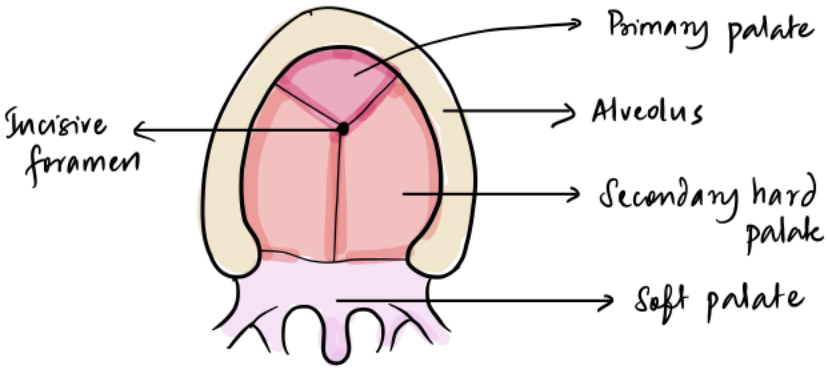
INVOLVES NASAL SILL & OPENS INTO ANTERIOR NASAL FLOOR

Simple Cleft - involves only lip

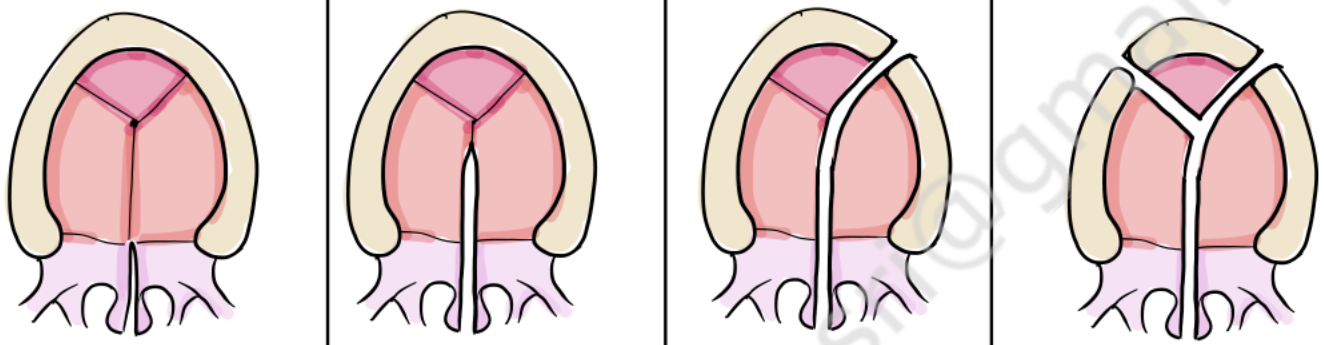
Compound cleft - involves lip & alveolus

SIMONART's BAND - A small bridge of skin/soft tissue present at the base of the nostril in an otherwise complete cleft

NORMAL PALATE ANATOMY



VEAU CLASSIFICATION OF CLEFT PALATE



CLASS - I
- Involves only soft palate

CLASS - II
Involves secondary palate - both hard & soft

CLASS - III
Unilateral Complete Cleft involving both hard & soft palate

CLASS - IV
Bilateral Complete Cleft involving both hard & soft palate

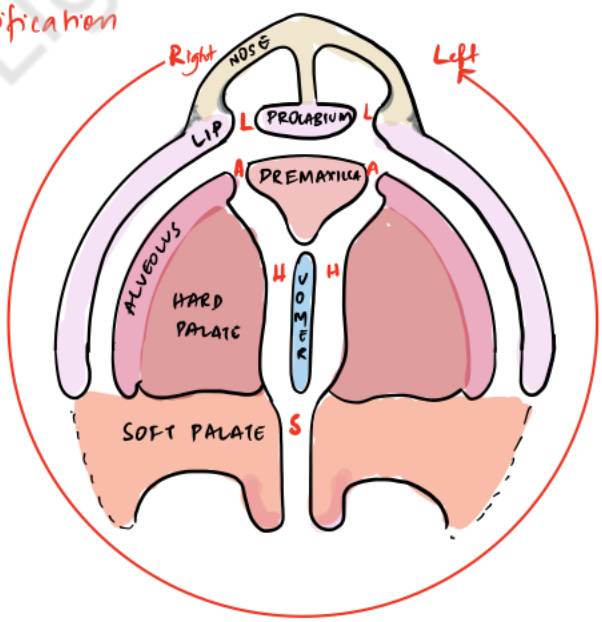
Incomplete: When clefted hard palate remains attached to vomer & nasal septum
Complete: When nasal septum & vomer are completely separated from palatine process

SUBMUCOUS CLEFT PALATE

Clefting of soft Palate musculature beneath intact mucosa

TRIAD
- Bifid uvula
- Midline translucency called 'zona pellucida'
- Palpable notch in posterior soft palate

LAHSHAL classification



LAHS - Caps for complete clefts
lahs - lowercase for incomplete clefts
L*a*h*s* - asterisks for microclefts

L - Lip
A - Alveolus
H - Hard palate
S - Soft palate

PROBLEMS ASSOCIATED WITH CLEFT ANATOMY

① Speech disturbances:

- Failure of velopharyngeal closure → Air leak through the nose → inability to build positive intra-oral pressure
- Difficulty in pronouncing labial and palatal syllables

② Feeding disturbances:

- Difficulting in sucking and swallowing

③ Eustachian tube dysfunction - due to disruption of tensor veli palatini
→ Frequent bouts of Otitis Media
→ Hearing problems

④ Respiratory obstruction
- in Pierre Robin sequence

⑤ Cosmesis and psychological issues – Abnormal dentition

MANAGEMENT

EVALUATION · Antenatal scan - cleft lip can be diagnosed after 18 weeks

PRINCIPLES OF CLEFT LIP AND CLEFT PALATE SURGERY

Goal: Restoration of normal anatomy of lip and palate
Emphasis on muscular reconstruction of lip, nose, face, soft palate
→ Normal/ Near-normal anatomy promotes normal function
→ Normal growth & development

Timing of Repair : Classically, Millard's rule of 10 was followed
- Baby should be atleast 10 weeks old
- Baby should be atleast 10 pounds in weight
- Haemoglobin should be ≥ 10 g/dL

Now, sequential repair is followed

DELAIRE SEQUENCE
- CLEFT LIP REPAIR – 3–6 m
- MAY BE DONE TOGETHER:
  - SOFT PALATE REPAIR - 6m
  - HARD PALATE REPAIR - 15–18 m

CLEFT LIP REPAIR-REVISION CAN BE DONE CONCOMITANTLY

CLEFT LIP SURGERY

Aims of surgery

1) Reconstruction / re-approximation of orbicularis oris
2) Cupid's bow
3) Pouting lower portion of upper lip (avoid colvistle deformity)
4) Philtral dimple
5) Straight columella
6) Symmetrical alae

SURGERIES FOR UNILATERAL CLEFT LIP

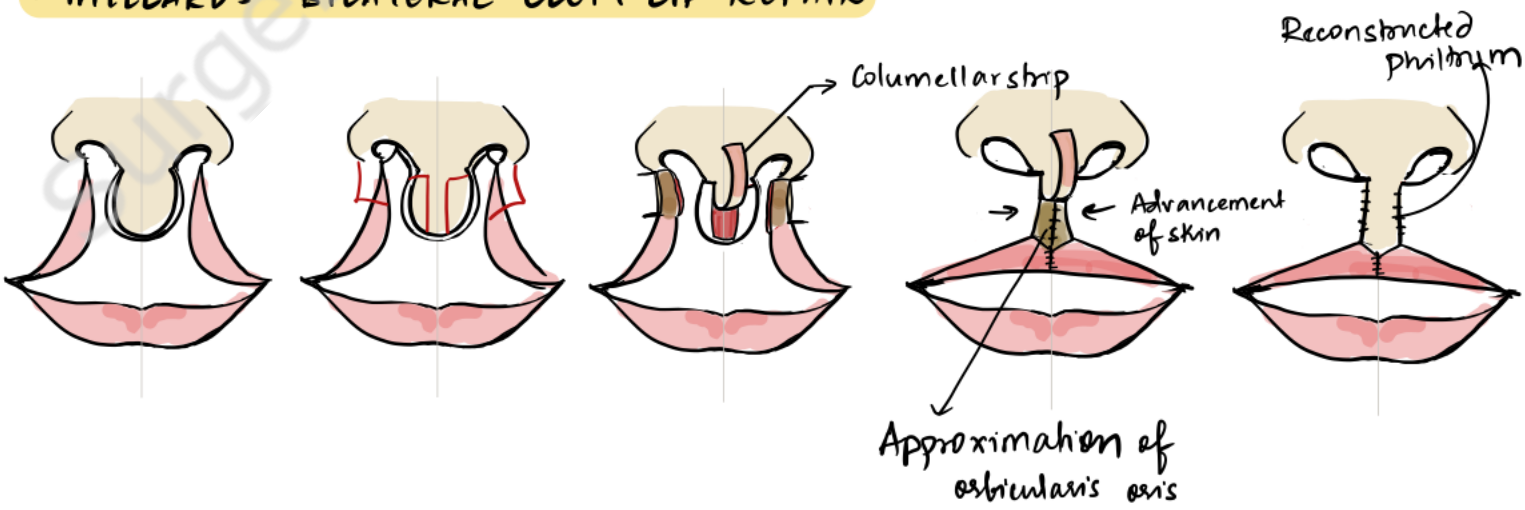
① MILLARD - ROTATION ADVANCEMENT FLAP

A = Advancement flap, C= C-flap R= Rotation flap

② TENNISON RANDALL TECHNIQUE

SURGERY FOR BILATERAL CLEFT LIP

• MILLARD's BILATERAL CLEFT LIP REPAIR

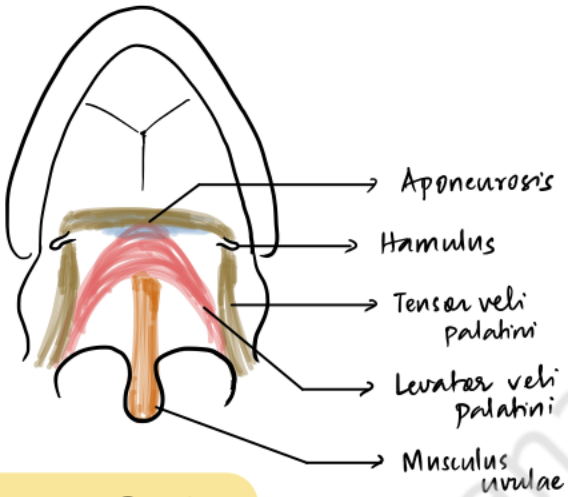


CLEFT PALATE SURGERY

Aims of surgery

- Creation of a mechanism capable of speech and deglutition without significantly interfering with subsequent maxillary growth
  - → Competent velopharyngeal mechanism
  - → Partitioning of oral and nasal cavities

Needs accurate re-approximation of muscles



SURGERIES FOR CLEFT PALATE

2 stage palatoplasty

1st stage - surgical reconstruction of aberrant soft palate musculature

2nd stage - closure of residual hard palate defect

Principle - minimal & gentle dissection to minimize subsequent scar formation
Layered closure
- nasal mucosa
- Bone
- Mucoperiosteal flap (oral mucosa)

PROCEDURES

1) FURLOW - DOUBLE Z PLASTY
2) VON LANGENBECK OPERATION - Large mucoperiosteal flaps, midline cleft closure, lateral Relaxing incision
3) WARDILL - KILLNER - VEAU OPERATION - V-Y advancement of hard palate mucoperiosteum for palate lengthening
4) VOMER FLAP

ADJUNCTIVE PROCEDURES IN CLEFTS : Alveolar bone grafts
Rhinoplasty
Osteotomies
Orthodontics

Secondary Management
Speech & Hearing
Orthodontics
Revision surgeries

Additional

1) Bailey & Love has an overview of various aspects of cleft repair
2) Sabiston only speaks of the sequence of repair
3) Schwartz has a fairly detailed section which is hard to read and assimilate
4) 'Plastic Surgery Facts & Figures' has some super specialty level stuff that can be daunting for less devoted seekers!
5) Plastic Surgery Secrets Plus is a decent review
6) MAMC Update 2010 has a decent section on Cleft lip & palate