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Rats and horses can't vomit.

DELTA® STATIONERY

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Only I can change my life. No one can do it for me.
It always seems impossible until it's done.

DELTA

Pathogenesis of Corneal Ulcer

Corneal Ulcer

- Infective
  - Mech
    - Infective agent
      - Bact
      - Viral
      - fungal
      - Protozoal
      - ↓
      - PMNs
      - ↓
      - Collagenases
      - Elastase
      - Cathepsin
      - ↓
      - Reactive fibroblasts
    - Vascularization
      - ↓
      - Inhibits ulcer as Nutrients (Ascorbate) & Antiproteinases
      - ↓
      - Kill Ulcer.
    - Immunological response
      - ↓
      - HSV keratitis IK
      - ↓
      - HSV Ag → stromal cellular destruction.
- Sterile
  - Epithelial defect → stromal melting

Stages of Corneal Ulcer

Progressive stage → Infiltration → Saucer shaped ass ⊆ gray zone of

Microbes adhere to epi ⟶ Release toxins/Enz → Tissue destruction.

Adhesion of bact by glycocalyx ⟨ Pseudo / Gono

Tear film → PMN. ← Limbal vessels

↑ size of ulceration

Deepening of ulcer

Walls → Swelling of lamellae by imbibition of fluid

Depth of Ulcer ↑.

Regressive stage → Brought by natural host defence mech

↓

Improvement in symptoms & signs

- Line of demarcation forms around the ulcer
  Margin & floor become smooth & transparent.
- consists of NBC that neutralize offending organism.

Accompanied by superficial vascularization.

Healing stage → Process of epithelization starts.

Histiocytes & keratocytes ⟶ fibroblast

↓

scar tissue formed

Vascularization toward ulcer site

Healing complete → ghost vessels formed (seen by indirect illumination)

- of scarring α depth of involvement

BM — x regenerate ; replaced by fibrous tissue

Process of cicatrization occurs

↓

Scar due to irregular lay out of C. lamellae.

Sequel & Complication

Sequel →

Severity of infection

- ↓ → Corneal Opacification
- ↑ → Thinning, formation of descemetocele, Perforation

Complication → Ectatic Cicatrix
Corneal fistula.
Hmeg.
Endophthalmitis.

Corneal Opacity

- Nebular
- Macular (>50%.)
- Leukomatous. (>75%.)

Descemetocoele

Eg. Pneumococci

↓

Rapid extension in depth

entire Cornea thickness involved & few spared (DM)

DM is unable to withstand IOP & herniates through corneal ulcer.

↓

Called. Descemetocele or keratocele.

↓

Surrounded by white cicatricial ring.

↓

eventually rupture.

Date
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Perforation

Due to Cough, Sneeze, straining

↑ IOP → floor of ulcer give away → Lens iris diaphragm moves forward.

Adheres to back of cornea

as ↓ IOP → Pain ↓ Extension of ulcer ↓
process of scar formation initiated.

Size of perf.

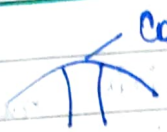
Small.
↓
Iris plugged to back of cornea
Adhesion & scar tissue formed ⇒ Pseudo Cornea.
↓
Iris plastered to back allow.
AC formed.
Aq. secreted.

Large.
↓
Iris prolapse out
fibrin & Exudate deposit on surf
↓
Iris turn out
Black pigmentary epithelium become visible
↓
Corneo Iridic Scar.

Very large Perforation
↓
Small rim of Cornea remains
Total prolapse of iris & lens occur
Suddenly → Suspensory lig gives way.
Subluxation of Lens
Expulsion of Lens & Vitreous.

Date
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Ectatic cicatrix — Ant synechiae / Plug of iris



→ Adherent Leukoma

↓

2° Glaucoma

Cicatrix tissue weak ∴ bcom ectatic

Ectatic ~~tissue~~ cicatrix into which iris is incarcerated

→ Ant staphyloma

Corneal fistula — ↓ perforation occurs near pupillary margin

iris adherent to back of cornea

Aperture filled ⊆ fibrin & exudates

↓

AC reforms, ↑ strain

Corneal fistula forms.

Hmeg → ↓IOP
↓
dilate Bld vessels
↓
IO Hmeg

Rupture of Retinal Vessels → VH → Expulsion of IO Contents
↓
Expulsive Hmeg.

Endophthalmitis → Organism → ulceration of Cornea.
↓ Ref.
Interior of eye
↓
Endophthalmitis.

Investigations

Date 12
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- Systemic
  - » sterile ulcers
    - Bld S/F PP
    - HIV
    - CBC
    - Urine analysis
    - Blood urea creat
    - IgM RF.
- Ocular.
  - on. Clinical Ix in Work up section
    - IOP.
      - Tonopen
      - ↓ in Perforated CU
    - USG
      - Cases of Corneal ulcers where Endophthalmitis is suspected.
- Clinical
- Microbiological
  - Collection of Samples.
    - Corneal Scraping
    - CL, CL case, solution
    - LS discharge.
    - x Conj Swab
    - AC paracentesis
  - Exam

Corneal Scraping

↓LA 0.5% Proparacaine

↓A – Children, Unco-operative adults & mentally impaired.

Instruments

- Kimura Spatula
- 26 g needle
- BP blade # 57
- Surgical blade No. 15.
- Ca Alginate Swab with kepticase soy broth
- Hypodermic Needles

caution:– Platinum Spatula

Tech.

- Speculum
  - ↓
  - Scrape
    - Edges → ↓ → Keep pn.
    - Base → ↓ → Moraxella.

Difficulty → In small, dry Ulcers
→ In severe Keratolysis & Descemetocoele

Exam

- Routine
  - KOH.
  - Gram.
- Special
  - Giemsa.
  - LN stain
  - Modified gram stain
  - Fluorochromatic Stains
    - Calcofluor white
    - Acridine Orange.

KOH Mount:

Scraping on slide

↓

10% KOH (freshly prepared) ⇒ Loosening Corneal stromal lamellae & exposing ⇒ fungal elements

↓

slide cover

↓

filament stains very light yellow.

- Fungus.
  - 92% Sensitivity
  - 96% Specificity.
- Acanthomoeba.

Gram stain

Romanowsky type stain. which uses Eosin, Ethyl blue & Azure dyes

- Stains DNA in nuclei of human cells
- Cytoplasmic RNA in lymphocytes

Procedure

5min vs 5s

↓

Fix the smear

Methanol 5-10min → ↓ Dry.

Pass slide through flame 2-3 times

↓

Flood ⊆ Crystal violet × 1min

↓

Rinse

↓

Gram I_2 × 1m

↓

Rinse

↓

Decolonizer solution

↓

Rinse

↓

Safranin stain × 30s

↓

Rinse

gram +ve → Blue purple
gram neg → appear pink.

61% accurate

done correctly
- Single Org → 75%
- Polymicrobial → 37%

Difficulties → Yeast in long reagents
gram -ve difficult.
Small smear.
Artifacts. — Carbon particles
Talcum powder
NaCl
Crystals
Melanin.
Granules.

Giemsa stain

Date
DELTA Pg No.

(*) form . gram . section

Uses

determine type of inflammatory cells + nt

diff. Bact & fungi
Chlamydia inclusion bodies
Cysts & teophozoites of Acanthoamoeba species

Bact → dark blue

fungi → purple, blue

Rev — Multinucleate giant cells

60 min .. vs 15 min . pH — 6.8-7 .

Procedure:

fix slide in coplin jar
↓
freshly prepared sol (2ml giemsa + 70ml . distilled H_2O)
↓
incubate slide in stain 35°C × 60 min
↓
Use 95% ethylalcohol
↓
Rinse

AF stain

Date 15
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Mycobacteria	+
Actinomyces	-
Nocardia	Variable

Principle: Resistance to decolourize by strong mineral acids

↓

due to presence of intact cells that contain specific lipid unsaponifiable wax fraction.

Carbol fuschin

↓

Δ

↓

Decolourize

↓

Methylene Blue

Calcofluor White. binds to chitin & cellulose

fungi → green. ⊆ CFW.

Cysts have chitin & cellulose stain bright green

A < Tropozoites — Reddish Orange.

Blankophore stain ⊆ CFW

Acridine Orange – Chemofluorescent

fungi & bacteria → yellow orange against green background when pH is acidic

Gram +ve, -ve bact

yeast, hyphal form of fungi

Acanthoamoeba – Tropozoite & Cyst

71-84 %.

↓

Can do gram stain also it

Modified Methamine Silver Nitrate Staining

Date 16
Pg No.

Gocott - Gomori

fungi » reliable than rest
- Background – faint green
- fungus & Septa – black

1% Warm gelatin over slides (gelatin coated slides)
Stored at -20°-0°

Sol

	A	B.
Borax	8ml	$AgNO_3$ – 7ml
Distilled H_2O	100ml	Methamine – 100ml

↓

A = B mix.

(2) Stock light green solution

Light green SF (yellow)	0.2g
Distilled H_2O	100ml
Glacial acetic acid	0.2ml

Fix

↓

Oxidize slide in Chromic acid 5% — 30 min

↓

Preheat Methamine sol 58-60°C

↓

↷ Slide × 20 min

↓

Amber coloured smear

↓

Rinse (6× H_2O)

Tone in 0.1%. $AuCl_3$ 2-4 min

↓

Rinse H_2O (2* change)

↓

2%. Na thiosulphate x2m — Remove I_2

↓

Rinse

↓

Counterstain 1:5 stock light green in distilled H_2O.

Date 17

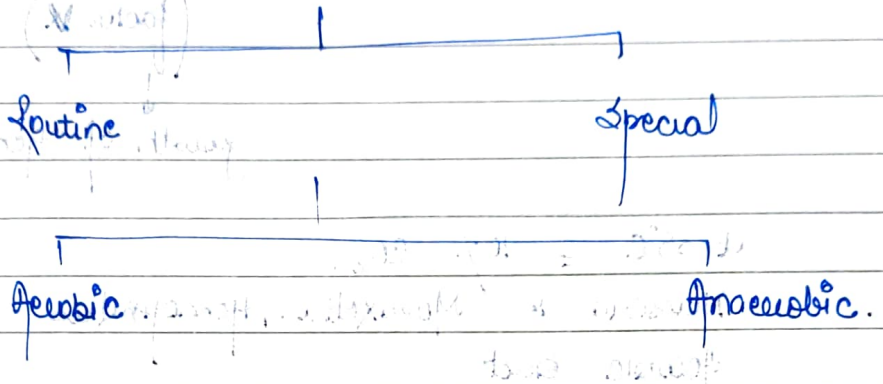
Culture ~~Media~~ Exam DELTA Pg No.

Gold std for Microbial Keratitis

↓

C shaped Inoculation — diff valid growth 4m contamination

Cotton tipped applicator — SDA.



Blood Agar. Enriched. Media

Isolate fastidious Org.

- Aerobic at 35°C
- Saprophytic fungi at room temp. + Nocardia
- Facultative Anaerobic bact

Seaweed + 5-10% RBC (Nutrients & index of hemolysis)

(Rabbit/Horse Serum) → Hemophilus.

Nutrient Agar — Simplest medium — 2% — 6-8 pH.

- Beef extract → Carb., N_2., Salts, Vit
- Peptones → N_2
- Agar → extract of marine algae → solidifying agent
- H_2O

Chocolate Agar — heat denaturation of blood

↓

provides

- Hemin (factor X)
- diphosphoridine nucleotide → (factor V) → growth of Hemophilus

at 35°C & 10% CO_2.

Neisseria & Moraxella., Hemophilus — H&M N

Aerobic bact

facultative Anaerobic bact.

SDA Agar

Glucose Peptone Agar Yeast extract

↓

Nutritional characteristic

Ab gentamicin CPM

↓

Inhibit bact decontaminat^n

× Cyclohexamide → else × Saprophytic fungus growth

↓

Ocular infections.

In Plant → Ease of inoculation
- observat^n of colony growth
- transfer to 2° media
- dilution of inhibitory substances to fungi

fungi & Nocardia

Thioglycollate Broth – ~~Aerobic~~
Obligate, facultative anaerobes

Sulfhydryl compound — act as an O_2 reducing agent

(X) → inability to restrict growth of anaerobic Org.

PRAS (Pre-reduced Anaerobically sterilized Media)
Ideal for Anaerobes

PRAS Brucella BA enriched with Vit K & hemin
↓
allow growth of anaerobes in 4-7 days
↓
Nutritional variant streptococci growth
ICK

Robertson Cooked Meat Medium → fav for Anaerobes

BHI (Brain Heart Infusion) — Neopeptone
filamentous fungi & yeasts.
Bacillus sps
» ocular → material is small
• provides more even exposure to essential nutrients

Thayer Martin Media
Enriched chocolate Media

−	+
↓	↓
Inhibitory Component	N. gonorrhoea.

LJ Media. Atypical Mycobact

contains egg & glycerol mixture. - fatty acid

solid.

Malachite green — inhibit AF. bacilli

read ≤ 1m 5-7 days upto 8 wk.

Nuceo ARD (Antimicrobial removal Device) — To remove AB

sterile beans — ambelite XAD4., C249.

Duration of Isolation of Organism →

growth upto 48hrs

liq - turbidity. look in C manner

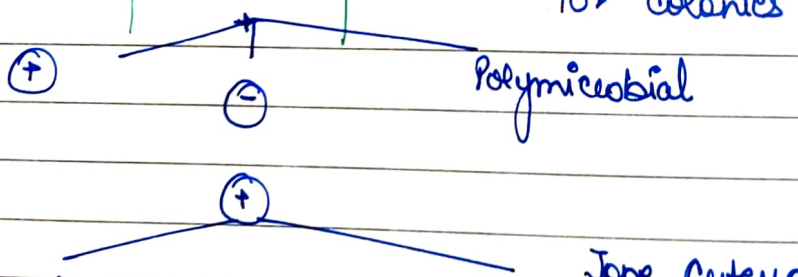
diff 4m conj - similar growth 4m conj samples

Aerobic — 7d.

Anaerobic — 7-14d

Mycobact & fungal — 4-6wk.

Interpretation of Culture reports →



- growth of Org in 2 or > Media
- Confluent growth of a known ocular pathogen in 1 solid Media
- growth in 1 Media of Org with 1 smear result + same Org in liq Media
- 1solid + 1 additional media
- fungi on any 2 media
- Any 2 media
- Smear + 1medium

Date 20
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Anaerobic – Pleiomorphic, slender, fusiform morphology on gram stain.
– growth in Anaerobic zone of liq medium
– dept of solid ..
– gas on liq media.
– failure to grow on Aerobic agar even if gram stain +

(–)

Steule ulcer.
1/2 AB Rx
Inadequate sampling methods.
Improper selection of Media.

↓

Suspect AB x24hrs

↓

Rescape.

Poly
gram +ve Cocci + gram neg rod

1 smear + 1 medium
2 5
15 + 1 other medium

Date
DELTA Pg No.

ABST — Std disk diffusion
Micro dilution tech

MIC →
PAE.

Molecular Dx

- Target amplification systems
  - PCR.
  - SDR
  - SDA
- Probe A.
  - LCR.
- Signal amplification

16s rDNA → Bact keratitis
18s → fungal

4hrs

Confocal Microscopy.

Large infecting Org → Acanthoamoeba. — Both Cyst & T.
fil. fungal
Microsporidial
Lyme Borrelial

Late disease → Enlarged. Corneal Nerves accompanying radial neurokeratitis
characteristic honeycombing pattern & Intrastromal scarring

HRT-II — RCM —. fil fungi
Candida.

Corneal Biopsy

Mycotic inf. , Intrastromal absc

- Incision, Spatula., Deep lamellar Excision.

LA → Dermatologic 2-3mm keyphine
Elliot microkeyphine
↓
1mm 3mm.

Bacterial Keratitis

Date 22
DELTA Pg No.

Predisposing factors →
- Corneal Trauma
- Eyelid disease.
- Ocular surface disorder.
- Tear film dysfxn.
- Previously compromised Local/systemic defense systems.
- CL use.

Etio

HIV keratitis — Pseudomonas
CL use — Pseudo, Staph, Serratia.
M.C — Staph.
Nocardia — Staph epididerms.
Listeria — Animal Handle

Classification of Bacteria.

Aerobe

	Gram +	Gram −
Cocci	Staph. Strep Enterococcus Cefazolin. Penicillin resist — Vancomycin	Neisseria ~~Branhamella~~. Peniallin FQ → Hemophilus
Rod	Bacillus • Corynebacteria • Listeria Gentamicin • (Cefazolin, Vanco, ~~FQ~~)	Pseudomonas Acinebacter Enterobacteria ← Ecoli, Kleb, Proteus Moraxella Cefazolin. Gentamicin (~~Ag~~) FQ 3rd gen. Ceftazidime
filaments	Mycobacterium — Macrolides Nocardia. — Amikacin.	

Bacteria that can invade healthy Cornea →

Neisseria
Corynebacterium
Hemophilus
Shigella
Listeria.

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Anaerobe

	gram (+)	(−)
Cocci	Peptostreptococcus.	Veillonella.
Rod	Propionibacterium. • Actinomyces — # Clostridium. •	Fusarium Bacteroids.
Spirochaetes	Treponema Borrelia. Leptospira.	

Penicillin.

Specific Organism

a) **Staph** MoC

Coagulase neg Staph epidermidis.

Compromised corneas

Distinct borders

Non Edematous surrounding stroma

Intrastromal abscess → corneal perf.

Multiple stromal microinfiltrate satellite ≈ fungi

Mild to moderate AC rxn.

b) Steep

Chronic dacryocystitis
following trauma. x healthy invade
Secondary infn ⊆ hypopyon
fibrin deposit ⊆ deep stromal abscess
⊆ intervening stroma relatively clear.
↓
Perf, melting. Serpiginous ulcer

∝ hemolytic steep → ICK.

Pseudomonas CL wearer, Immunocompromised

Rapidly evolving inf. → Perf & Loss of eye.

Epi defect + Superficial edema + infiltration of stroma
c in 6hrs of trauma

↓

Extends deep c in 18-24 hrs. Extensive involvement

Diffuse epithelial graying away from site of epithelial & stromal infiltration

↓

Ring ulcer c in 48hrs of untreated infection

green. Yellow mucopurulent discharge

↓

Descemetocoele & perforation.

gram +ve aerobic bacilli f/b injury

gram -ve rods → Kleb, E. Coli → Indolent ulcers & c mild AC rxn.

Moraxella Malnourished, alcoholics, DM, ICompromised pt.

Oval, Inferior part of Cornea

Corynebacterium. — penetrate intact C. epithelium.

Actinomycetes. ⇒ Nocardia. . After trauma.
⇒ Canaliculitis.

Clostridium — gas bubbles in C. tissue / AC.
under epithelium

Date
DELTA Pg No.

Na Spore forming anaerobic Org. — Animal bites
Propionibact → Bacteroids, fusarium.

Non TB. Mycobacterium. LASIK.
M. fortuitum → Crack Windshield app. ✓

Nocardia — Indolent ulcer
↳ fungal ulcer elevated hyphate edge
satellite lesions
Cracked Windshield appearance

Date
DELTA Pg No.

cf:-

Symptoms as earlier
& Org. pt condition

Eye Signs

Inf.

Cells & debris

Nou Inf

Bulbar conjunctival tear film & Meniscus

× over area. Epithelium.
of active infection

Suppurative.

Stromal inflammation

- Ass Conj → Gono, Pneumo, Hemophilus
- discharge.

Bact that can invade intact Cornea

Neisseria
Corynebacterium.
Hemophilus
Shigella.
Listeria.

MCL SN

Medical Rx

Broad spectrum A·B drops
Topical Cycloplegic agents
Antiglaucoma medications
Use of Lubricants.

A·B

scrape → AB
↑ ↓ shop

Mono Rx

Cipro - 0.3 %.
Oflox 0.3 %.
Gatiflox 0.3 %.
Mokiflox 0.5 %.

↓

Antig resist Pseudo.
MRSA
Neisseria.

Combination Rx

Cephalosporin — gram +ve cocci
-ve rod

Aminoglycoside — gram -ve.

Fortified — 5% cefazolin
+
1·3% Tobramycin SOy
hrly x 2days
↓ 3d
4hrly

Ix Small Corneal Ulcer
not involving visual axis

5% cefta. → neg

Vancomycin 5% → +ve

Routes

- Topical
  - fortified.
- SubCon.
- Systemic
  - Scleral Involve"
  - Perforated Cornea
  - Impending perforation
  - Cauld inf — Hemoph
    Pseudom

- β lactams
- Teteacyclines → static 30s
- Macrolide. 50s
- Glycopeptides
- FQ. → cidal
- Aminoglyc → cidal 30-50s

+ve

C. Trachomatis
NTB.

FQ

- 1st
- 2nd → Cipro
- 3rd → Levo.
- 4th → Moxi
  - Gati.
  - gram +ve.
  - Atypical MB
- C8 Methoxy FQ

Adjuvant

- Cs → ↓ Inflam & Scar → >> Pn risk.
- Cycloplegics → ↓ pain induced by Ciliary Spasm.
- Anti glaucoma → Topical → β blocker; Systemic

48hrs after AB. given
└ Org identified
× fungus.
× Thinning

Nocardia → Trimethoprim — 16mg/ml
Sulphamethazole — 80mg/ml.

Af +ve — Amikacin 1% - 2% only
also FQ.

Sx Rx

- Tissue adhesive → Perf < 3mm → Cyanoacrylate glue.
  - Progressive stromal keratolysis
  - Thinned descemetoceles
  - Dry bed.
- Patch graft. → upto 5mm → encompass 1mm of normal cornea. in keephanated area
- TPK

Signs of Healing

- Signs & symptoms ↓
  - VA ↑ improve.
- Stromal infiltrate consolidate.
- AC rxn. ↓
- Epithelization. Complete.
- Necrotic stroma → Scar tissue.
- Vascularization → ghost vessels.

Signs of Progression / No response →

- ↑ size of infiltrate.
- Epithelial defect.
- Ht of hypopyon.
- Corneal thinning.
- Perf.

Neurotrophic Keratitis

Involves various ° of deg Corneal & Conj changes 2° to loss of sensory fxn / in pathway of nasociliary br of trigeminal N. ± tear production.

Characteristic — Breakdown of Corneal epithelium

∴ ⊗ — desiccation, infection., trauma.

↓

PED. if not Rx

↓

Deeper layers of Cornea. & Leads to Perforation & Melting

Etiology

- Ocular.
  - HZO
  - HSV
  - Lyme's disease
  - CL wear
  - Trauma to Ciliary N
    - Diathermy / Laser / Cryo
    - Corneal scarring
    - Corneal Rx
    - Cataract Rx.
  - Topical drugs
    - Timolol
    - Diclo
    - Atropine.
  - DS Toxicity
    - chemical burn
    - Corneal dystrophies. — Lattice / granular.
    - Addie's syndrome.
- Systemic.
  - DM
  - Leprosy
  - Vit A def
  - V N palsy
    - Tumour
    - Trauma
    - Rx
  - Congenital
    - goldenhar
    - Mobius.
  - Toxins.

Pathogenesis → Regeneration centripetally from periphery
↓
X, Y, Z hypothesis
Corneal Anaesthesia. → ↓ reflex tearing.

Diagnosis

History — Asymptomatic, Blurring of vision
Rec. pain, watering, ↑nce of blisters on the face
Etio ↑/o.

Exam — eyelids
↓ tear film + ✕ sensations over Nasal mucosa
Iris atrophy ⊆/⊆ out AC ↑xn — HZV, HSV, Leprosy

Corneal sensations

Dilated fundus Exam — DM, Laser Scar

Systemic Exam, 8th N Exam — Acoustic Neuroma
✕ → CS pathology.
Pupil — APD ↑ ↓ sensation → Intracranial lesion
Thyroid., CTD, Immune disorder
Sensations of skin & Nasal Mucosa.

Stage 1

I
Rose bengal staining of palpebral Conj.
↓ TBUT.
↑ viscosity of tear Mucus
Punctate epithelial staining ± fluorescein.
Scattered small facets of dried epithelium (Gaule spots)

II
Acute Loss of epithelium ⇒ UL.
Surrounding rim of loose epithelium.
Stromal edema. ⟶ Punched out ulcer
Ag. cells & flare.
Edges of defect become smooth & rolled with time

III
Stromal lysis., 2° inf.
↓
Corneal perforation.

Stage 2

- Withdraw epitheliotoxic drugs
- Ocular lubricants
- BCL.
- If deficient tears — Punctal plugs
Tetracycline 250mg BD | → ↓ mucus.
Doxycycline 100mg OD.

- Ocular lubricants
- Growth factors → NGF, EGF, laminin Fibronectin, albumin
- Transpore tape & patching
- Tarsorrhaphy - Windshield wiper action of eyelids

- Collagenase inhibitors → Topical Cysteine NAC - 20% EDTA - 0.2 mol/L Tetracycline
∴ ↓ stromal meltdown

- Tissue adhesive
- Conj flap
- AMG — PK.

Stages of N. keratitis by Mackie

Corneal Sensations

- Pattern
  - Patchy
    - ↓
    - Local Condition HZK.
  - Segmental
- Degree.
  - Prominence & beading of C. Nerves
    - ↓
    - Subte sign of Lepromatous. Corneal involvement
      - ↓
      - 4 Quad & central area.

2 Method

- Cotton Wisp Method.
  - ↓
  - Central → next Quad.
  - Least in central & horizontal meridian.
- Cochet & Bonnet Aesthesiometer
  - > accurate.
  - 0.12mm Nylon filament

Grades of Sensitivity

Blink reflex	felt by pt	Corneal Sensitivity	Cochet Bonnet
+	✓	Normal	> 55mm
X	forceful application	diminished	50-54mm
X	X	Complete Anaesthesia	< 30mm

DD

Neurotrophic Ulcer	Herpetic Epithelial Keratitis
Impaired Corneal Sensations Damaged BM of epithelium	Active Viral replication.
Interpalpebral area	Any site.
Oval or heaped epithelium at borders. Slow & no change in size of ulcer over a period of time.	Dendritic Ulcer. Branching pattern ⊆ terminal bulbs ⊆ swollen epithelium. Rapid changes in size of ulcer
Margins of ulcer × stained ⊆ Rose Bengal.	✓

Ix

- Diff 4m Herpetic
- If Superadded Infection → Scrape.
- MRI of Orbits & Brain → ↓ NV deficit

Collagenase inh. → NU → stromal lysis

Chemical burn → MMPs ⊕ ← ⊖ → Proteolytic degradation

① Destruction of gene expression of Neutrophil collagenase & epithelial gelatinase.

Tetra.	250mg QID	4-6wk.
Doxy	100mg BD	

Tissue adhesive. Histo-acryl (Isobutyl Cyanoacrylate) + BCL.

If perf <2mm

Mech → ↓ → remove Neutrophils frm stroma by creating hypoxic environment

- Antibact action.
- Promotion of NV & postponing keratoplasty

Conj flap:
- ↓ Inflam
- ✓ Cosmesis
- Pt to Invasive Rx

Gunderson flap — Extensive stromal destruction ⇒ poor visual prognosis

AMG – used for filling cavity of ulcer
a) restoring stromal thickness
b) Rapid wound healing
c) effective barrier for inflammatory cell entry
d) ↓ synthesis of chemotactic factors & ↓ corneal inflammation.

fungal keratitis

Epidemiology

developed. → ↓ ↓

developing → > Microbial k.

On India → Aspergillus — 27%.
Fusarium — 6-32%.
Penicillium — 2-29%.
» Warm & rural areas

Risk factors

Ocular.
- Trauma. — Vegetative matter
- Chronic Corneal inflammation.
- CL Wear — » filamentous fungi
- Drugs
- Corneal Surgery — Suture related problem
  Topical steroid
  Failed graft & PED.

Systemic
- DM
- HIV
- Leprosy.

Classification of fungus.

Taxonomical

- Aseptate
  - Mycelium
    - × → Synchytrium
    - ✓ → Oospore produced by union of – gametes
      - dissimilar (Oomycetes)
        - Phytophthora
        - Pythium
      - Similar (Zygomycetes)
        - Mucor
        - Rhizopus
        - Lichtheimia.
- Septate
  - Ascomycetes
  - Basidiomycetes
  - Sexual reproduction × known (Deuteromycetes)
    - Fusarium
    - Colletotrichum
    - Cercospora
    - Alternaria
    - Microspora
    - Trichophyton.

Ascomycetes

Round	Cup.	Flask
– Erisiphe	– Ascobolus	– Neurospora
– Penicillium	– Peziza	– Saldenia

Basidiomycetes

↓

No. of spores

definite

↓

Basidium

Septate.

↓

Puccinia

Contmous

↓

Agaricus
Coprinus

Indefinite

↓

Ustilago
Tilletia

Morphological

Yeast

↓

Cyptococcus

Yeast like

↓

Candida albicans

Moulds/ filaments

↓

Dermatophytes
Aspergillus
Penicillium
Rhizopus

Dimorphic fungi

↓

Paracoccidiodes

Coccidiodes

Histoplasma Capsulatum

Sporothrix Schenckii

Blastomyces dermatitidis

~~Signs & Symptoms~~

Another Way

- Filamentous
  - Septated
    - Non Pigmented (FAP)
      - Fusarium
      - Aspergillus
      - Acremonium
      - Paecilomyces
      - Penicillium
    - Pigmented (Dematiaceous) (CAC)
      - Curvularia
      - Alternaria
      - Cladosporium
      - Lasiodiplodia
      - Colletotrichum
  - Aseptate
    - Rhizopus
    - Pythium
    - Mucous
- Yeast
  - Candida
  - Cryptococcus

Symptoms — less severe
Insidious onset.

Sign

Infiltrates — greyish, white, yellow
Base — soft, creamy, ↑ exudates.
Elevated areas, Hyphate ulcer., Irregular feathery margins, dry rough texture, satellite lesions.
Fixed hypopyon.
Immune Ring.
Endothelial plaque.
Post corneal abscess
DM folds
KPs.
AC ↓xn.

Pigmentation — Alteration in melanin metabolism.
→ Superficial infection.
→ Low virulence of Organism.
→ ↓ Inflammatory ↓xn.
Intact epithelium ⊆ deep stromal infiltrate.

Fusarium solani — >> Severe course.
deep extension & perforation.

Aspergillus → ↓ severe.

Yeast — Collar button configuration.
- Small Ulceration ⊆ expanding stromal infiltrates.

Lab Dx

- Direct microscopy
- Culture
- New Modalities
- Biopsy

- KOH Mount 70-90%.
- Gram stain 81-98%.
- Giemsa. 27-85%.
- Lactophenol Cotton blue 70-80%.
- GMS stain 56%.
- Calcofluor white 80-90%.

Culture

- Sheep blood agar.
- SDA
  - 50mcg/ml gentamicin + Cycloheximide
    - 25°C → yeast
    - 37°C → Moulds/filamentous.
- Thioglycollate broth
  - Anaerobic bact
    - 35°C
    - 37°C

+ve if → 2 smear +
+ & 1 medium
* smear >1 medium
Confluent growth of fungus.

Newer Modalities

PCR.

Confocal uscopy.
↓
Non invasive.
hyphal elements
yeasts.

Mx

- Debridement useful
- Natamycin 5%.
- Broad spectrum A.B — FQ.
- Cycloplegics — 2% HA. TDS
- Antiglaucoma

Longer Rx
day — hrly
Night — 2hrly

Improve ↓ infiltrate
↓
2hrly
↓
Continue 2wks after resolution

Worsening
↓
Amphotericin.
± fluconazole

Amphotericin — 0.15%.
fluconazole — 2% — fungistatic / Candida Aspergillus

Candida

↓

1st line Amphotericin
fluconazole — 0.3%.

Econazole 1% ⇔ 5%. Nata.
Clotrimazole 1%.

Imidazoles systemic use as ↓ toxicity

Voriconazole — all 0.5µg/ml
1% — recalcitrant fungal Rs

Drug interaction →

Synergistic — Antagonism

Candida → AmphoB + flucytosine — AmphoB / Imidazoles

Aspergillus — — Natamycin + KetoConazole

Systemic → Very large ulcers
severe deep keratitis
Scleritis
Endophthalmitis

Itraconazole	200mg/day
fluconazole	200mg/day
Voriconazole	200mg BD
Ketoconazole	600mg/day

Intracameral Rx — severe keratomycosis not responding to topical Natamycin

Amphotericin — 5-7.5µg / 0.1ml 5% dextrose.

Intrastromal Rx — Intracorneal Ampho B. 5-7.5µg

Technique of Surgical

- Debridement
- Biopsy
- TPK
  - 1-1.5mm clear cornea.
  - Interrupted sutures with slightly longer suture.
  - Irrigation of AC
  - No lens touch.
  - Inject intravitreally if req.
  - Send corneal button for HPE.

Post op systemic A.B.

Viral Keratitis

HSV | HZV | Adenoviral

HSV → I, II

i° — Recurrent

6* > after keratoplasty
» Atopic & Immunosuppressed

Infection

Act virus.

Sources →
- Direct contact of infected lesions
- Saliva droplets or fomites
- Iatrogenic
  - Dr unwashed hands
  - Sciotz.
- Asymptomatic Virus shedding carriers

HSV-1 — fever, blisters
HSV-2 — genital herpes.

Resides in Trigeminal ganglion. ← Trigger:
- fever
- Hormonal changes
- UV exposure
- psychological stress
- Ocular trauma
- Excimer laser.

Immune Mech. —— > Stromal inflammation
Endothelitis

→ Secretion of glycoproteins is responsible for stromal inflammation

df

Congenital

On basis of

- Intra uterine — 4% — ↓ Asc Inf
- Time of birth — 86% — ↓ genital exp
  - Skin vesicle
  - Eye disease
  - Micro encephaly
- Postnatal period — 10% — ↓ Relative

Neonatal

↓

- diffuse microdendritis
- Segmgenous ED
- Punctate keratitis

D.D — infant c non purulent conjunctivitis or keratitis

↓

Topical antiviral
Systemic Acyclovir
20 mg/day IV 5 daily x 14 d.

Primary

After 6 months of age

- Perioral dermatitis
- follicular conj
- LN palpable

Recurrent

Blepharitis
Conj
Keratitis
- Epi
- Stromal

Uveitis
Trabeculitis
CR.

Trigger →

Manifestations of keratitis

BL only in 3%
» common in atopy & young.

- Epithelium
  - Infectious EK
    - Punctate K
    - Dendritic
    - Geographical
    - Marginal.
  - Neurotrophic keratopathy
    - Metaherpetic lesion
- Stromal
  - Immune stromal K.
  - Necrotizing stromal K.
- Endothelium
  - Endothelitis.
    - Disciform
    - Diffuse
    - Linear.

Punctate K.

Punctate, stellate whitish opaque plaque of swollen epithelial cells.

Dendritic K.

Plaque enlarge branching dendrites
Epithelium in centre sloughs to form dendritic ulcer.

Single. Multiple.

have linear or terminal bulbs
raised edges & replicating virus
Central / Paracentral
Ulcer → ↓ Sensation. Surrounding Cornea — (N)
Ulcer — Fluorescein. edges — dead cells — Rose Bengal.

Date
DELTA Pg No.

Geographic Ulcer Amoeboid shape
Advantis have virus laden devitalized epithelial cells — + Rose Bengal. bt toxic. ∴ if PCR to be taken shd be before stain.

Marginal Ulcer. confused c Staph. Marginal disease
↳ Serpintic ulcer + nt marginally
→ Near a Blood vessel
→ Stromal infiltrate + near area of limbal Inj

Marginal Ulcer

	HSV Keratitis	Staph.
Etio.	Infective.	Immunologic
Epi defect	+	×
Progression.	Centrally	Circumferentially
limbal Inj	»	Minimal
Lucid Interval bt limbus & ulcer	×	+ ✓
Neovascularizat^{n}	+	×
Elephantis	×	+ ✓
Location..	Any meridian	2, 4, 8, 10

Sequelae of SEK → . Complete resolution.
. Sectorial epitheliopathy.
. Ghost pattern of sub epi branching pattern
. Stromal keratitis
↳ Dense scar → Corneal thinning

Neurotrophic Epithelial keratitis / Trophic / Indolent / Metaherpeti
Serious HSV Epithelial disease.
↳ Impaired Corneal innervation.
↳ ↓ Tear formation
↳ ↑ by use of topical Antiviral agents

Recurrent epithelial erosions
Persistent sterile ulceration — Neurotrophic ulceration.
Round. Oval ulcer.
≤ Thickened, Rolled up margins.
≈ Amoeboid Herpetic ulcer. ∴ diff b/t 2.

complications →
Scarring.
NeoVasc.
Necrosis
Perforation.
2° Bact infection

	Neurotrophic U.	Infectious U.
History of Recurrent epithelial inf.	+	+
Anti Viral Rx	Nurse	Rx
Duration of ulcer	Long	Short.
Location.	Interpalpebral	Anywhere.
Size.	Almost Constant.	↑ or ↓.
Margins.	Shallow, clean	Raised, grayish.
Loss Sensation	X.	+

Stromal keratitis

Epithelial Ik. | Endothelitis.

Immune Sk.

- Interstitial K.
- Type III Immune Rxn.
- associated c deposit of Ag-Ab. complex.
- Clinically – Stromal Infiltration
  - NeoVasc.
  - Thinning of Cornea.
  - Recurrent Inflammation.
  - Ulceration ±

2° Lipid Keratopathy

→ Punctate Stromal Opacities
- ass c Rage
  - focal
  - diffuse.
  - Multifocal
- ass c Ac Inflammation.

→ Immune Ring of Wessely
- circular deposit of Ag-Ab. complex c PMN Infiltration.
- Complete / Incomplete
- mt / in Mid / Stroma.
- double ring of Wessely.

Necrotizing Sk.

→ Direct Invasion of HSV in C. Stroma

→ Active Viral replication.

– Immune Stromal Inflamma

occur if –:
- Steroid ✓ Antiviral not g

C. necrosis
Ulceration.
Dense Infiltration of Stroma
Overlying epithelial defect

2° complications →
- Hypopyon
- Uveitis
- Post Synechiae.
- Glaucoma.
- Retrocorneal Memb.
- Cataract.
- Perforation.

→ Steornal NeoVasc

Acute — Chronic

Sectoral — Circumferential

ghost vessels ⊕

Endothelitis

Delayed type IV HST oxn.
∝ Location of KPs.
+nt of Overlying edema.

Disciform.	Diffuse.	Linear.
disc shaped	Corneal edema.	overlying diffuse Steornal edema.	progresses 4m. limbus – Centre.
few	KPs	scattered	Linear line
–	Corneal Pufulcate.		
–	Vasculorization		
	Iritis +		
diffuse Central Eccentric.	Area of Involvement	Immune fn. against C. Endothelium.	
May resolve.	» attacks of IK.	& ⊆ topical steroid	

complication → recurrent Non granulomatous Ant Uveitis
Trabeculitis
Ac Puff → may + iris atrophy, Post synechiae &
Iris thing.

Lab. Inv

- Giemsa stain — Multinucleate giant cells
  Cowdry Type A inclusions

- PCR — HSV in tear film., Corneal scrapings
- Viral Culture — Cytopathic effects.

- Immunological tests →

Paired sero Test — diff 1° & Past Ocular recurrence

ferritin tagged Ab — diff HSV1 & HSV2

Herpcheck — Ix sorbent assay.

Medical Rx

Virostatic.

inhibit viral replication by interfering ⊆ protein synthesis

Vidarabine	3% Oint	5TID.	↘ 3TID 1wk,	21d
Trifluridine	1% sol.	2hrly	↘ 5TID	
Acyclovir	3% Oint 200, 400mg tab.	5TID.		
Valacyclovir	1g	3TID.		

Infectious Epithelial Keratitis → Physical debridement.
Topical Antiviral agents.
cycloplegics
Tear substitute (as Viral drugs are epitheliotoxic) Wash out cytokines.
x steroid unless stromal involvement.

If req. 3% Acyclovir 5TID x ~~5d~~ 21d
↓
1% Prednisolone 2-4hrly
] tapered over 6-8 wk.

↓

If No response. May reescape for Acanthomoeba

1% Trifluridine — 9times/day.

Bromivyl deoxyuridine — HSV epithelitis

Date
DELTA Pg No.

~~Neu~~trophic keratopathy → Protect damaged SM.

Stop Antiviral
Use lubricants
BCL.
Surgical tarsorrhaphy
Botulinum inj.
Conj flap.
AMT.

+ Collagenase Inhibitor ⟹ systemically.

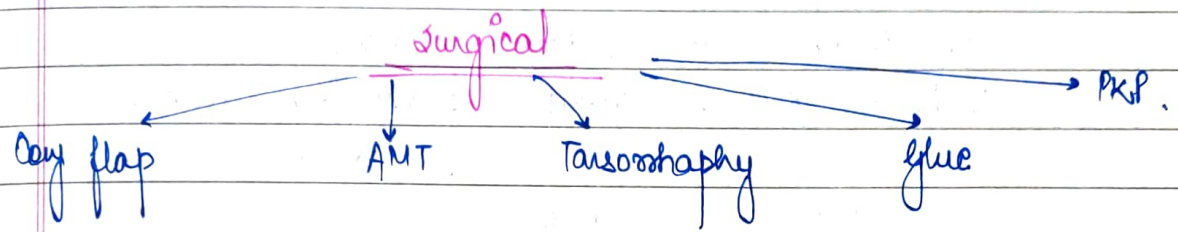
Steomal keratitis

Immune	Necrotizing
Topical antiviral + C.S.	Topical C.S + 3% Acyclovir Oint- HA
	Very slow tapering ↓ ∴ ↓ secy
Endothelitis: Topical C.S + 3% Acyclovir	If not possible ↓
Cycloplegic	Low dose steroids 0.01% Dexa 0.125% Prednisolone.

HEDS Study

Oral Acyclovir added in case of severe uveitis among STD
In cases of severe uveitis / or If live virus is isolated from AC.

Cyclosporine 0.05%. HSV non Necrotising SK unresponsive to HSV SK.



↓
Recurrent HK
& no potential vision

Complications of PK — Corneal graft rejection
Herpes recurrences in graft
PED
Corneal Melting
2° Inf.
Graft failure.

Recurrence — 12-49%
2/> episodes in a year.

CS role — ↓ Cellular infiltrate"
Corneal scarring
NV
Toxic hydrolytic Enz

HZV infection

Benign Exanthematous illness + Prodromal symptoms + rash vesicular.

Altered CMI, Immunosuppressive agent, Organ transplant pt, Syphillis, TB, HIV

Ocular HZV lesions → Pocks on lid margins
- keratitis occur rarely in cases of VZV
- Ek ⊆ or ⊆ out pseudodendrites
- disciform K ⊆ uveitis of varying duration
- ARN, PORN, iridocyclitis

	HSV	Dendrites	VZV
Overall	fine, lacy		Thick, ropy
Epithelium	Linear defect ⊆ based stroma. Surrounded by edematous epithelial cells		Elevated, painted on appearance.
Staining	Base – Fl. Border – Rose Bengal		Min Fl staining
Terminal bulbs	frequent		x

Rx — Acyclovir — Oral 800 mg 5TID × 10-14d
I.V
⊆ 72hrs of appearing rash

ARN can occur 5d — 3 mth
Optic Neuritis can occur.

On Page 47

Adenoviral infections Shipyard eye.

EKC 8, 19, 37

Contamination →

8 days of incubation Uni — Bil

findings → Severe follicular KC.
Palpebral edema
Preauricular LNpathy
Hmeg Conj

stages I → Corneal epithelial vesicle like elevations which are 25-30μ Barely perceptible on slit lamp.

II — Deep epithelial PK.

III — Subepithelial infiltrates + Deep PK.

IV — Nummular Opacities.

Molecular Assay
RT-PCR.

Mx
Cold Compresses
Artificial tears
Topical Vasoconstrictors
steroids BD - QID
Cidofovir

Non Healing Corneal Ulcers

~~HEDS~~

If despite Mx there is :-

↑ in ulcer dimension

↑ size of existing hypopyon over 48hrs

Cause

- Wrong dx
- Inadequate dosing
- Raised IOP
- Impacted f.b
- Necrotic slough
- Lid Abn
- Neurotrophic element
- Poor Ocular surf
- ↑nce of suture / Exposed knot
- Systemic cause - DM, ISx

Approach

- Detailed H/O
- Corneal sensat"
- Drug Toxicity
- Exam of lids & ocular surf
- Scraping for virus.
- Repeat culture & ↓N
- Rule out reservoirs of Inf Lacrimal scc

Non Inf

PED

Rounded edges

>> Peripheral vascularisation

Inf

>> Symptomatic

↑nce of infiltrate

Hypopyon +

fuzzy Margins

Mx — Debride

Antix.

Freq Lubricat"

Temp Tarso

~~HSD82~~

Date
DELTA Pg No.

46

Rx

- Maintain str integrity → Glue
- Scaffold tissue breach → AMT. / Conj flap → Gunderson / Superior fornical Conj advancement peduncle
- Replacement of infected tissue → - Corneal Transplant / - PKP - CXL.

Non Healing Neurotrophic Ulcer

- Diabetic Epitheliopathy → No. Anti Viral Rx → Add tear substitute → Persistent / Enl
  - Scalloped edges → IC pt → Check Host immune status / Consider IV Acyclovir
  - Acyclovir resistant HSV Inf → Stop Acyclovir / Start Vidarabine
- True Ulcer → Neurotrophic → Smooth borders

HEDS

I	II
SKN	SKT
SKS	APT.
IRT	RFN.

SCUTT

Steroid in Sact

↓

Only if × Nocardia

↓

if ≤ in 3 days then only beneficial.

Nocardia → » Scar.

MUTT

1 — Topical Natamycin
Voriconazole.

2 — Topical Voriconazole.
Oral.

↓

× role

Nata better

800mg 5TID ×10d
- ↓ Period of viral shedding
- accelate time for healing by 50%.
- ↓ Incidence of new lesions
- ↓ severity of pain.

Started no later than 4 days after rash

for pain — Opoids may be needed

Systemic steroid → Progressive proptosis & total ON palsy & ONeuritis
↳ as Occlusive Vasculitis

Eye → Antiviral not required

↓

If Sclerits or Scleorsing keratitis or Iritis

↓ Ischaemia fibrotic scaring.

↓

Dexa 0.1% 4hrly + Antiviral 5TID. steroid ointment at night

If — Valacyclovir 1g TDS, famciclovir 250-500 mg TDS

IV → Encephalitis or Moderate-severe Immunocompromise
5-10mg/kg TDS.

Post herpatic Neuralgia

Acute shingles

Eye disease

Acute
- Ek
- Conj
- Episcleritis
- Sclerits
- Nummular K
- IK
- Disciform K
- Ant Uveitis
- Post Uveitis
- ↑IOP
- Neuritis

Chronic
- Neurotrophic Keratopathy
- Sclerits
- Mucous plaque K
- Lipid deg
- Lipo filled granuloma
- Subcon/eyelid scarring

Relapsing

HHV - 3

Cornea

- Epithelial keratitis
- Nummular stromal K
- Disciform K.
- Limbal vascular K.
- Neurotrophic K.

- Glaucoma Reasons
  - TM plug by debris
  - PB. 2° to PAS
  - PAS
  - COAG → after acute infection

- Pupil — Horner Syndrome
- EOM — Myositis — Ophthalmoplegia.
- Post herpetic Neuralgia — > 120 days after rash.

Dx. — Lipschutz bodies — Multiple eosinophilic intranuclear inclusions

Tzanck Preparation.

Protozoal Keratitis

Date
DELTA Pg No.

Acanthamoeba.
Microsporidia

Acanthamoeba.

culbertsoni
castellanii

Unil. »
CL wearer. » Soft Contact Lenses.

Risk factors → CL Wearer. — Swimming pool.
Contaminated H_2O / Homemade solution.
C. Trauma.
Orthokeratology.

CL → 1st gen Silicon hydrogel CL > 2nd gen Balafilcon A > Galyfilcon A.
Least for daily disposable.

Life Cycle

Symptoms

Severe pain
f.b sensation
Redness
H_2O ring
Mucus discharge
↓ Vision
Photophobia.

Waxing & Waning course
↓ ↓
Cysts Trophozoites

Signs

Epithelial stippling = Microcystic edema
fine epithelial subepi curvilinear opacities
Dendritiform epithelial lesions.

Radial keratoneuritis — Linear, radial, branching infiltration by parasites along Corneal Nerves in Ant stroma. Begins paracentrally & extends into limbus in a radial pattern.

Stromal inf → dense single or multiple stromal infiltrate
» Ring infiltrate
Epithelium Intact
Intrastromal abscess can occur

Ring shaped stromal infiltrate — Pathognomic
PMN infiltrates generated by chemotaxis after Ag-Ab ppt due to collagenolytic Enz

HZV, Aca

Pseudodendrites
PE erosions
Stromal thinning & furrowing
Satellite lesions
Stromal ulceration & perforation.

Other
Lid edema.
Conj injection + Chemosis
Iritis, Hypopyon.
Cataract & glaucoma.
Prominent sclerits.

Mod
- Herpes
- Fungal

Herpes.

Dendritic lesion ulcerate

Small stromal infiltrate.

Acanthoamoeba.

Pseudodendrites elevated at the Centre.

Gelatinous appearance of Cornea.

CL <<

~~Acanthoamoeba herpes fungal~~

Severe pain
Annular infiltrate
Radial keratoneuritis

Fungal.
stromal infiltrate.
Endothelial plaque.

Laboratory diagnosis

Corneal scraping, Hot smear. CL exam

Staining

- Giemsa
- Calcofluor
- Methylene Blue.
- Congo Red.
- Janus green.
- Lugol sol.
- Acridine Orange

Gram & PAS ✓

GMS – Inflammatory cells mix.

Gram/giemsa fails → Calcofluor → » Cysts × Tropho
0.1% → 0.1% Evan blue counter.

Calcofluor — Troph – Red Brown — difficult as × stain
Cyst – Apple green

- Fluorescein Conjugated lectins – Concavalin A ✓
  wheat gram agglutinin stain.

Culture Media E.Coli on NNA & sealed

37° 25°C.

Nutrition source – E.Coli, Aerobacter, Enterobacter, Klebsiella Pn, Xanthomonas

Trophozoites track. & fact unable to fill the path
↓ serial transfer as no ↓ & PMN → Pseudopodials

CL specimen — × counter stain of Evan Blue.

- PCR.
- Corneal Biopsy — Epithelium Intact bt. active stromal lesion.
- Confocal Microscopy —

Rx

Propamidine 0.1%. (Brolene)
Neomycin 1%.
Cationic Antiseptics — Chlorhexidine 0.02%.
PHMB 0.02%.

hrly × 72-96h
2hrly × 2-4wk.
QID × 6-12mth

Topical Cycloplegics, NSAIDs

Surgical

PK — LK — AMT.

Paediatric Keratitis

» Gram +ve Cocci

- Intro
- Epidemiology
- Predisposing factors — Trauma
  Systemic factors — Measles, Diarrhoea, fever, Vit A def.
  CL Wears
  Pre-existing eye dx
- Etio — Bact — gram + Cocci
  - Microbial — Viruses, fungus.
  - Non Microbial keratitis — Nutritional
    VKC. — shield ulcer
- Diagnosis — H/O fever, rash, diarrhoeal disease
  Immunization status of child.
- Clinical Exam — Systemic. — Ocular.
  Nutritional status
  Malnutrition
  Vit A def.
  Pre-auricular LNpathy
- Ix — Ocular
  Systemic — Wt for age
  Wt for Ht
  Serum Vit A levels
- Lab Inv — Scraping ↓ LA.

- Mx — Nutrition
  Vit A therapy → in cases of keratomal

Vit supplementation
- >1yr — Oral — 2 lac IU in oil (110 mg retinal palmitate, 66 mg R. acetate)
- i.m — 2 lac IU H2O sol vit A.

Mx — Bact / fungal / Herpetic / Acanthamoeba.

- Follow Up
- Sx Rx
- Post resolution Mx — Scar Mx
- Prevention.

CL related keratitis

Date
DELTA Pg No.

» permanent effect → stromal acidosis in endothelial polymegatism — characterized by ↑ variation in corneal endothelial cells.

Events related to CL Wear →

I Clinically Non Significant
- Asymptomatic infiltrative keratitis
- " infiltrates.

II Clinically Significant.
- CL related Peripheral Ulcer
- CL related acute red eye.
- Infiltrative keratitis.

III Serious
- Microbial keratitis.

Lab. Ix

Acanthamoeba cysts show bright apple green fluoresce against reddish orange background.
Indirect If staining tech, Fl. conjugated lectins — Acanthamoeba. Sps identification.
Req. f. uscope for Visualization.

Infectious Crystalline Keratopathy.

following keratoplasty.

- Indolent Corneal Infection c needle like branching crystalline opacities

No actual deposits of crystals.

Risk factors

- Ocular
- Systemic
  - Immunosuppression

- Ocular Surgery
  - Corneal Transplant
  - Epikeratophakia
  - Relaxing incisions
  - Gf. Sx. c. 5FU.
  - LASIK.
- OS disorders.
  - PED
  - Chronic Herpetic K.
  - OCP.
  - Corneal scars
  - Acanthamoeba K.
  - Exposure K.
- Topical drugs
  - CS
  - AB
  - Anaesthesia abuse.
  - Antiglaucoma
  - Antiviral

Etiology ∝ Hemolytic Steep. (Steep Viridans)

Fungus — Candida albicans.

Acanthamoeba.

Date
DELTA Pg No.

Pathogenesis – Apex to corneal stroma occurs via break in corneal surface or through sutures

↓

glycocalyx production — shield org frm immune recognition

Corneal stroma. ↔ Intrinsic property of Organism

Reason for crystalline growth → Criss cross lamellar architecture of corneal stroma.
– Represents path of least resistance to expanding bacterial colonies.

Intralamellar pockets — single lamellar plane.
Overlying epi — intact
Collagen lamellae adj to collection of bact — undisturbed

Clinical features Foll keratoplasty — lesion of suture track, ED., location of loose. suture removed or replaced.

– insidiously progressive gray white branching opacities c/h corneal stroma
– Vary in appearance frm small, round, stellate opacities to large branching needle like opacities extending across entire cornea.
– Isolated frm single lamellar plane
– Min. signs of AS inflammation

- Annular infiltration confluent & progressive melting & endothelial plaque formation. & satellite lesion

Mimic Ca^{2+} deposit in corneal stroma.

Laboratory diagnosis

Scraping
Corneal button after K.

→ Microbiological Ix.
→ Histopathology. → Light
→ Electron. — Bact org & distinct. laminated cell wall.

→ Confocal uscopy →
- Needle like. deposit at varying depth in stroma.
- Amorphous deposit grouped at different levels in stroma.

Treatment

A•B. — poorly replicating bact ∴ less effective against slowly replicating. — interfere cw synthesis. eg.

- Encasement of bact in Biofilms.

Medical
fortified AB.

Surgical
>50% — × Rx
TPK req.
↓
Lamellar → Virulent Org
Pseudomonas A.
Mycobacterium

- Excimer LASER ablation.
- YAG LASER application.

Peripheral Ulcerative Keratitis

Date
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Intro - crescent shaped destructive inflammation of juxtalimbal C. stroma. ass c ED
+nt stromal inflam cells
Progressive stromal deg.

Etiology Always think of infective first.
staph → fungal → HSV.

Pathogenesis – Limbal capillary vessels c/u 0.5 mm into clear cornea. (+1 mm)

	Inf.	Non Inf.
Ocular	Bact – staph.	Mooren
	strep.	TMD
	Viral – HSV.	PMD.
	Acanthoamoeba.	Blepharitis
	Fungal	KCS.
Systemic	T.B.	RA.
	Syphillis	GCA.
	Varicella.	Wegner's G.
	Gonorrhea.	SLE
		Sjogren.

C/F

Rx + CVD → Scleritis + Pain
Systemic H/O

Date
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Exam

Systemic → Any lesion on face, trunk
Evaluation by Rheumatologist.

Ocular

Ocular → Corneal Sensation
Schimer test.
& Ulcer describe + Scleral involvement → diffuse, nodular, necrotizing

Ix

CBC | ESR | BUN | RF.
ACE | ANA | ANCA | Anti Type II Ab.
Complement C3, C4. | HBsAg

Imaging. → Chest Xray, Sinus CT — WG

µBiology. → Scraping

Biopsy.

Histo findings

Rx

If x infection → give → 1% Medroxyprogesterone QID
20% NAC

Discuss immunosuppressive drugs -:

- Bed
- Methotrexate
- Azathioprine
- Cyclosporin A.
- Cyclophosphamide.
- TNF α Blockers

Specific Diseases

Rheumatoid Arthritis → KCS, MGS, PUK, Scleritis
Naked peripheral thinning & Marginal furrows

Wegner Granulomatosis → Granulomatous Necrotizing vasculitis
– Resp – Renal involvement.
Conj, Scleritis (× in Mooren)
cANCA – 99% specific 96% sensitive.

PAN Small & Medium sized arteries. Histopathological Identification of Vascular changes. Choroidal Vasculitis PUK, Conj lesions, Scleritis, Choroiditis, CRAO
× Mooren. HBsAg +ve.

Other CVD Dry Eye (KCS) PUK.

Staph Marginal Keratitis – + Chronic Blepharitis
× Pain significant.

association c
Erythema elevatum diutinum

Non Inflammatory

TMD

» O→ Asymmetrical
Superiorly
Fine punctate stromal opacities
Clear zone in b/t
Superficial Vascularization.
Intact epithelium
Peripheral thinned zone is determined by a white lipid at its central edge.
Oblique Pseudopterygium.

SPD thinning of ~~limbus~~ interval b/t limbus & arcus senilis.

Rosacea Keratitis Cutaneous dis → Persistent Erythema
Telangiectasia, papules, pustules
hypertrophic sebaceous glands of face & neck

- Chronic Blepharoconj
- NV., thinning

Oral tetra + doxycycline + steroids x 4-6wk.

Mooren's Ulcer

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chronic — Type III HST rxn.

↳ nt of overhanging edge overlying corneal & leading edge that starts in periphery

↓

May progress centrally & circumferentially to involve entire cornea.

♀ >>.

Hallmark ∝ clinical presentation & Ant seg fluorescein findings

Unil — Bil

Bil: Agressive, Indolent

Types of Mooren

Type I
- Benign.
- Unilateral
- Older ppl.
- Respond well to Medical & Sx.

Type II
- ~~Older~~ Malignant
- Bilateral
- Younger pt.
- ↓ response to Rx
- >> Pain.

Pathogenesis

Autoimmunity

Ag to ulcers → inflammatory cells, Ig, ↑ expression of HLA class II molecules

Cross rxn c Helminth Antigen

Heavy neutrophil infiltration & dissolution of superficial stroma.

Cf

Pain >>>

Redness of eye, tearing, photophobia.

↓VA — due to irregular astigmatism

several patch peripheral stromal infiltrates that coalesce in region of palpebral fissure.

Dx

Systemic Ix
Scraping

Mx

Medical Mx

Topical C.S
Pulse steroids
Topical tetracycline,
Medroxyprogesterone. 1%.

Systemic Immunosuppression
↓
Bil relentlessly progressive.
Mooren's ulcer not responding

Surgical Mx

a) → Limbal conjuctivectomy
→ Keratoepitheliaplasty
→ Keratoplasty

a) 2 clock hrs on either side of ulcer.
4mm posteriorly

Pg 134

Eye Banking

Date
DELTA Pg No

Activities → Identification of suitable donor
→ Trained staff to approach families to offer. option of dona
→ Meticulous screening of doctors to assess donor risk
→ Donation acc to recognised std & procedure
→ Evaluation of Cornea by slit lamp, specular
→ fair & equitable distribution of tissue
→ Donor family support — Bereavement counselling to. maintainence of Anonymity.

Regulation & Quality System

FDA approved. 3 rules. Most imp → cGTP → Current good tissue practices for Human Cell, Tissue & cellular tissue based establishments, Inspection & enforcement for prevention of communicable diseases.

Donor selection

Contea I : for use of donor tissue → designed to ↓
- Viral transmission of disease
- Transmission of Bact/fungal infections.
- " " Malignant disease
- Transplantation of corneal disorders

disease transmission from donor Cornea → 3 categories :-
- Prion disease
- Infective
- Malignancies
- Intrinsic eye disease

Prion

Infectious — Hep B, HSV, Rabies, HIV
Bact. fungal

Malig. → Rb.

Donor Age

No influence of donor age
× < 2 yr — ↑ Using infant tissue
- Complicat" of Post op Myopia
- Thinness of infant Cornea
- Myopic shift after K.

Donation of eye tissue

- Consent
- Medical health review → COD., Past, Medical H/O
- Serology testing
- Prep of donor — 5%. ↓ 0.1-5% iodine
- Enucleating / in situ Excision / Os Lim Sectoring

Corneal Evaluation

- Gross
- Slit lamp Evaluat" — Guttae Vs Pseudoguttae
  - Steeds #
  - Storage in hypothermia

Endothelial Iscopy — decompensation 300-500 cell/mm²
1500-2000 — × PK or EK

Specular -
Light "

HEPES — Hydroxy ethyl piperazine N ethane Sulphonic acid
MEM — Minimum essential medium

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Storage

Max upto 1mth.

Moist Chamber Storage → gauze mastered ⊆ saline or antimicrobial solution. at 4°C

✓ Only for 24hrs
Toxic build up of Metab waste & necrotic tissue in stagnant Aq. humour.

Hypothermic Corneal Storage →

(a) MK Medium — Mc Carey & Kaufman.

TC 199 + Dextran = MK. 2-3 days
↳ Osmotic agent. HEPES — Buffer
Phenol red - Indicatn Penicillin, Gentamicin
Polymyxin
(b) MK + HEPES buffer.
MK (penicillin, streptho) ↘ gentamicin. — » gram -ve Bact

(c) MK + Chondroitin Sulphate (2.5%) → K-Sol → extended storage time 7-10 days
absorbs LMW moieties & swell.

(d) Dexol → MK + CS + Dextran.

(e) Optisol / Corneol. Maintain Endothelial Cell Morphology & thickness of Cornea. 7-10 days 2-6°C.

(f) Optisol GS

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Normothermic Storage → (Organ Culture)
30 days
→ ↑ detect" of bact
→ Accept tissue for Septic
→ Upto 24hrs also if donor
cooling process

glass bottles

100ml MEM medium + Earle's salts +
2-5% foetal bovine serum + L glutamine +
Antimicrobial agents → Penicillin, Streptomycin, Amphotericin

Incubated in dry (non CO_2) environment
at 31-37°C

Inbuilt surveillance System.

MK Medium → Optisol GS Eusol C Life 40C → Corneal → Eagle's MEM 34°C

4d | 7d | 14d | 4wk

Cryopreservation

Covid 19 Times

Glycerol preserved at -80°C
γ Irradiation
freeze drying & Lyophilization

Post op Inf.

- Lim swab
- Lim culture.

Future trends

- femto assisted tissue cutting.

Enucleation

whole eyeball — Corneoscleral button.

- Prior to Preparat^n
  Clean area
  On Situ Exam.
  Rinse & swab
  Preparat^n of surgical pack.

Preparat^n
Clean area & deap^n
& x
Restoration.

Eye banking laws in India →
Transplantation of Human Organs Act 1994
" " Human Organ Rules 1995

EBAI — Eye Bank Association of India.

- Written Consent
- Even if in will → Consent of relative req

- Authority for removal of Human Organs
- Authority for " " " " in case of unclaimed bodies in hospital or Prison
- when being sent for Post Mortem

- Restriction on removal & Transplantat° of Human Organ
Offences & Penalties — 2-7 yr Rs 10,000

Corneal Transplant Centre.

Req -:

- Eyebank of choice — List of patient acc to priority for lamellar procedure may cut tissue 1 day prior
- Patient Co-ordination & Education. — Proper Info risk, Benefit. Warning Signs
- Hard availability / Staff / Education
- Anesthetic Staff
- OT issue — Speciality Theatre Nurses
  Lasers in Corneal Sx.
  Special Equipment
- Follow Up
- Checklist for Booking a case
- Research
- Wet Lab
- Audit & Out Come Monitoring

Setting up a Eye Bank.

Date
DELTA Pg No.

Eyebank — 1 for 20 million people

- 40 EBC (Only harvest Cornea)
- 10 HCRP (Hospital Cornea Retrieval Programme)

Problem Statement

↓

India Blindness

↓

1 lac transplant req.

∴ double Harvest! 2 lac

↓

Each EB ⟶ 4000 Cornea/year.

∴ ↓

50 EB

1/2 eyes from EBC. — 2000.

1/2 frm HCRP. — 2000.

Eye Bank —

- Board of directors
- Medical director
- EB Manager.
- EB Technicians
- Grief Counsellors

Date
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fxn of EB — Educating ppl
Carrying out eye donations
Processing donor Cornea
Serological test
Distribution of Cornea
Initiating HRCP
fund raising

EDC 2-4 lakh 25 eyes
fxn — Tissue retrieval 4m donor
— Transportation of tissues to nearest eye bank for processing, evaluation.

Feasibility

Existing eye bank. → ? ← Hospital located.
Population → ? ← Distance of Hospital 4m EB/EDC ≤ 15km
Financial viability

If can support existing — One shd try for that

- Population & Total population for Eye donation
- Hospital in local area & their potential for eye donation
- Financial Viability
- Location of Center
- Requirements for an ideal Eyebank set up | Table #
- Assistance

Criteria for Eligibility → • Organisation registered under Human Organ Transplantation act
- NGO. & x run for profit
- financial position satisfactory.
- Own infrastructure to carry out activities of EB.
- Good track record of Org
- Affs ⊆ EBAI

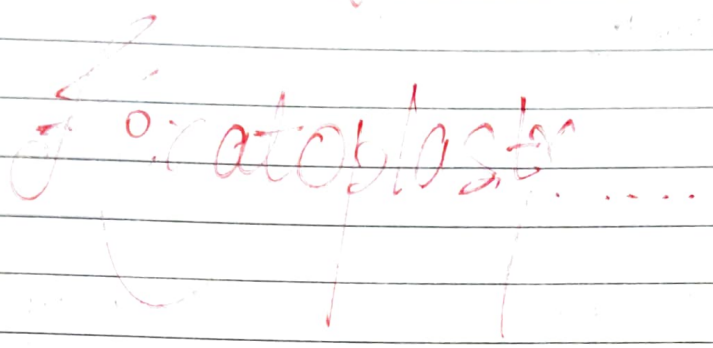
Pattern of Assistance →

EB
- Non Recu. 5 lakh
- Recurring 500/eye collected for MK media, glassware.

EDC
- 50,000 for kit
- 250/eye

- Procedure of Application
- Legal formalities

Penetration



Indications

Significant improvement → Improvement of 2 lines
Snellen line

Ix
- Optical
- Tectonic
- Therapeutic
- Cosmetic

Optical PK — < 6/18, 90% PK

- Developed
  - Keratoconus
  - PBK.
  - Fuch's
- Developing
  - Corneal Scarring
    - Infection
    - Trauma
    - Malnutrition

Others
- PBK, ABK
- Stromal Corneal dystrophies
- Endothelial dystrophies
- Ectasia / Thinning
- Congenital Opacities
- Viral / Post Viral Keratitis
- Microbial / Keratitis
- Nutritional def
- Corneal Degenerations
- Chemical Inj
- Mechanical Trauma
- Regraft

Tectonic PK — Restoration of Ocular Anatomy

- Thinning / Ectasia
- Corneal perforation
- KC, KG, PMD
- Corneal Melting ass ⊇ AI disorders
- Corneal fistula.

TPK — Therapeutic — Infectious keratitis to eliminate infectious load

- IK not responding to Antimicrobial therapy
- Non Responding Fungal / Acanthamoeba Keratitis

↳ Temporary KPro — Visualization of fundus to perform Retinal procedures — PPV
Photocoagulation
Repair of Complicated RD

Cosmetic → Rare procedure bcas of other modalities

Expected Outcomes after PK.

Cat 1 — Excellent
- Keratoconus
- Lattice dystrophy
- Early Fuch's

Cat 2 — V good
- PSK
- ASK
- Fuch's
- Herpetic keratitis
- ICE
- IK
- Macular dystrophy

Cat 3 — Fair Prognosis
- Keratoglobus
- PMD
- CHED
- Corneal Opacities
- Chemical injury
- Dry Eye.

Cat 4 — Poor Prognosis
- Ocular Pemphigoid
- SJS.
- Congenital glaucoma
- Multiple graft failure

Collaborative Corneal Transplant study factors ∝ survival of graft :-

Ix of graft
Graft number in ipsilateral eye
Corneal Vascularization at time of graft
Presence of Ant synechiae during Sx.
H/O previous ↑ in IOP.
Mode of Aphakia & Pseudophakia.
H/O previous 10 Sx
Recipient age < 40 yrs
Graft size < 8 mm.
Time of preservation of Cornea > 6 hrs
Bld grp ABO incompatibility.

C/I for PK

Absolute
↓
PL neg

Relative
- Advanced Dry Eye disease
- Grade IV Chemical burn
- OCP.
- Severe SJS
- Ant Staphyloma.

Pre-Op Evaluation

- Ocular History — Antiglaucoma.
- General History
- Ocular Exam → UC VA
  BCVA.
- Gross Ocular Exam. — Lacrimal position.
  Stenosis
- Ant Segment & Iris.
- Lens
- IOP
- Fundus Evaluation
- Ix — Refraction.
  Tear film. Status
  Keratometry
  Gonioscopy
  Pachymetry
  Specular Microscopy
  Confocal "
  Laser Interferometry
  Videokeratography
  Slit Scanning & Scheimpflug Imaging
  UBM
  USG
  Electrophysiological tests.

Surgical Instruments for PK.

Instruments for globe Exposure → Eye Speculum
Globe supporting Rings
- Flieringa
- Mc Neill goldman.

Corneal Marking Instruments →
- Radial Keratotomy Markes.
- Vajpayee Corneal Markes.
- Arts " "

Corneal Trephines

Eye globe fixatron → Tudor Thomas Stand.
Guage piece fixated

Cutting Blocks →
- Paraffin.
- Teflon.
- Poly Carbonate.
- Nylon.

Kauffmann Corneal Cutting Block.
Bright bill Polytef " "

Corneal Endothelial punches
- Cottingham
- Troutman
- IOWA PK Bess
- Liebeeman.
- Rothman Gilbard

Cutting Instruments → Blade Brakes
Diamond knife.
Corneal Scissor

Grasping instruments →

- Toothed
  - Pierse Hoskin
  - Colibri
- Non Toothed
  - Mc pherson
- Special fxn
  - Double Corneal forceps – colibei style
  - Colibei style — Polack double corneal forceps.

Holding instruments

Spatulas & Hooks

Qualitative Keratometers →

Keratometers & Microscopic attatchment

Handheld keratometer

Technique of Penetrating Keratoplasty

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Pre-Op Preparation →

- Infection Control
- Decrease In Corneal Neovascularization –
  - Steroids
  - electroCautery
  - Argon Laser PhotoCoag
  - Adrenaline soaked Sponges.
- IOP Control
  - I.V Mannitol
  - Honan Balloon.
- Pupillary Management – × dilate
- Donor Corneal tissue Management.

Anaesthesia. → GA → Perforated Cornea.
Inflamed Eyes.

Surgical Preparation → Painting & Denting.
Exposure & Insertion of Lid Speculum
Placement of Scleral fixation Ring
- High Myopia.
- Pediatric Age group
- KeratoConus.

Trephination of Donor Cornea → Donor is cut before. host
- Graft Host Disparity
- Ways to Harvest Cornea
  - Whole globe
  - Processed Corneoscleral button.
  - Using artificial Anterior Chamber
  - Non Mechanical
  - ~~Laser~~ Trephination.

Graft Host Disparity

Acc to Baron if diameter of recepient Bed

- >9mm <7mm (-10.5)
  - 1mm Oversize.
- 7-9mm
  - Aphakic
    - 0.5mm
    - Oversize
  - Phakic / Pseudophakic
    - 0.25mm

Recepient Bed size

- 7.5mm
  - 4D.
  - Oversize of 0.5mm Induces Myopia
- 8mm
  - 2D.

No Refractive ~~set~~ error — 0.25 mm

Date
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Oversize & Tech of Harvesting donor graft

Harvesting donor graft from whole globe stored in Moist chamber using handheld or suction fixation tech.

↓

Same size or 0.25mm. oversize.

Harvesting the donor graft. 4m preserved Corneal button

↓

Oversize. 0.25 mm – 0.5mm.

↓

It has been observed that Cornea cut from endothelial side are 0.2mm smaller to those cut from epithelial side

Trephination of recepient Cornea

↓

Limbal white to white

↓

- > 12.5mm. → 8.25 - 8.5mm
- < 11.5mm. → 7.5 - 7.75mm.

Types of graft

Same size

Ix
- Keratoconus

Advantage
- To compensate for associated myopia

Disadvantage

Smaller size
<6.5mm

May be as patch graft but usually <3mm

- Sutures come in visual axis view
- High Astigmatism
- Result in flat cornea not amnable to CL fittings
- Less endothelium transplanted which is ↓ desirable for endothelial disease

Oversize graft
>8.5mm

- Paediatric
- TPK
- Corneoscleral scar

- More endothelium available
↓ chances of drop in vitreous cavity in Aphak
- Pacd & CI Scar anticipating shallow AC
∴ Large grafts.

» chances of graft rejection due to ↑ proximity to limbal vessels

2) ↑ IOP due to PAS formation

Date
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Tephination of donor Cornea

- 4m. Whole globe stored in Moist Chamber using hand held or Suction fixation keratomes
- Harvesting 4m punched Corneoscleral button.
- Using AC Maintainer.
- Now Mechanical Laser tephination

- Marking the host Cornea.
- Tephination of Recipient Cornea.
  - Diameter of Pt Cornea.
  - Extent of Corneal disease.
  - Avoidance of use of very small & very large graft.

Hand held | Suction tephine | Now Mechanical

Suturing of donor Cornea

- Placement of donor Cornea on Recipient
- Placement of Cardinal Sutures 12 & 6 Oclock 3×1×1

Needle is passed anterior to DM.

- Placement of Other Sutures
- Knots burry
- Check for Wound leakage.
- Intraop Adjustment for Astigmatism

Microscope: Terry's | Mires: Maloney & Mandel's | safety pin.

Date
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Intra Op medication & Post Op Regime

- Antibiotics — Topical
  Local Acyclovir 400 mg 5TID for 1-3 wk.

  Systemic if :- Pre-existing External eye infection
  Prosthesis use in fellow eye.
  Penetrating trauma
  Combined procedures

- CS → Ix → High Risk. PK.
  Pt develops Inflammation
  KP on graft
  ↑ CT

- Antiglaucoma — Timolol 0.5% BD
  if :- Pre-existing glaucoma
  PK combined with
  - Cataract Sx
  - Vitrectomies
  - Lysis of Synechiae
  - Use of large amt of hyaluronate
  - Ant Seg reconstruction

- Cycloplegics — hardly if Initially
  else PV KC pt — Permanent pupillary dilatation
  Uveitis Tavalia. Syndrome
  ↓
  └ Wide dilation — Synechiae formation
  Crowding at angles.

- Lubricants — Epitheliotoxic drugs — with Caution.

Suturing Techniques in PK.

factors Contributing to Astigmatism → Pre-existing Corneal thinning, Vascularization.
- Eccentred keephination of donor & host
- Oversized grafts
- Pre-existing KeratoConus
- Quality of Wound healing
- Astigmatism of donor eye.

Types

- Single interrupted suture Tech
  16 → 24 → 32
  Young Paed PK
  Vascularizatn in Host (Early removal)
  Multiple previous reject
  Inflammatory Conditions
  Rejection.
  Ulceratn.
  ✓✓
  Easy to place
  allows suture removal
- Combined Continous & Interrupted suturing T
  Ix
- Single Continous suturing Tech.
  ↓
  4 Cardinal suture
  ↓
  22 bite Conti suture
  95% depth
  10-0 Nylon
  ↓
  Now remove Cardinal suture fill BSS → then tie at 12 O clock else Barrel toping ⊆ flat Cornea.
  X
  - difficult.
  - Irregular bite remove all
- Double Continous suturing Tech

Tech

a) large graft → >> suture.
avg depth → 90%.
Bury in host. → as ↓ Vascularization
Other bury in host → ↓ tension in graft &
↓ dehiscence.

b) 12 interrupted 12 Continous
Epithelial portion lie close to interrupted suture
Not midway — sup segment midway
∴ little support.

95% depth
11-0 merselene also used.

c) ✓ Merselene

Torque	Antitorque.	No Torque
↓		
CC 0.7mm 11°	Anticlock same	Isosceles Δ ∴ x rotation
✓ leads to Astigmatism	distortion in deeper layer ∴ ↓. Post op Corneal Astigmatism	Intrastromal bytes & overlying suture at same depth ↓ splint act^{n} x C. distortion





d)

4 Cardinal Suture

~~Interrupted~~ 1) 12 Bite → Nylon → 80% depth knot Superficially

2) Alt b/t. 50-60% depth

Suture adjustment & Suture Removal

↓ Post op Astigmatism × Spherical

final → either | hyperopia.

Corneal steepening

Early — Late

<2wk ~~2wk~~. >1mth

↓

Refraction → Keratometry → Topography

Ix for suture removal → Scarring

Vascularization.

Suture Breakage.

Loose Interrupted Sutures

Pronounced Inflammation

Infiltration around Suture

↓ After 3mth if Astig >4D

↓ Then Remove

If below <4D → follow for 1yr.

Suture removal

Tech

(a)

Removal → flattening

If very tight as early 6wk

If <1yr pt – removed. all suture ≤ in 8wk

(b)

2-3 mths after PK

✓ → Only tight suture removed

✗ → Only steep axis flattened

– difficult to remove after several years

Tech

(c)

✓ → >1 adjustment

Early rehab

✗ → attempted

only facilities of repair available.

(d)

deeper removed

↓

Shallower left.

Post Op Care after PK.

Date 80
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- Freq clinical exam in initial period → To detect rejection.

AB
↓
until epithelial defect is healed

Steroids
↳ ↓ Post op inflammation
↳ ↓ Immune sensitivity
↳ chances of rejection

~~Std~~. Post op Care (POC)

Std.

Std. POC → In Uncomplicated corneal grafting
↳ SubConj steroid
↳ Intracameral A.B — ?
↳ ↑IOP — Oral Diamox.

Criteria for discharging pt frm hospital →
Stable Vital Signs
Return to Pre Op Mental state
Absence of Nausea
Absence of Unusual pain
Availability of an escort.

1st Post Op day

Eye protected 4-6 wks.
Assess • VA • degree of pain • Slit lamp Exam

Wound leak → Relative hypotony
Unusual stromal swelling
shallow AC.
Siedel test

Date
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Rx → BCL

Ag production inhibitors

Leak > 3d. —— resuture wound.

- Pupil shape
- Corneal / epithelial status
- Extreme AC shallowing
- ↑IOP
- Early signs of infection

AB.

QID.

7.14d.

till epithelium healed.

Steroid

FML – 0.1%.

Bedacetate – 1%.

QID – 6TID.

Fimexolone – 1%.

x Pred.. NaP → x potent

Monitor IOP & status of Lens.

Regime for steroids →

Month	Duration 4-6wks	
1		
2	4TID	FML acetate
3	3TID.	
4	2TID.	
5	4	FML alcohol.
6	3	
7	2	

Post Op Visits

Slit lamp Exam → Rejection — Corneal stromal thickening
fine epithelial edema
Ag / flare & cells
KP.

If KP. does not ↓ ⊆ steroids ⇒ give Topical cyclosporin A.

- Detugence of graft — Pachymetry
- fundoscopy — ON, Macula, Peripheral retina
- Persistent epithelial defect > 14 days
  Look for Ocular Surface. & — Lubricator
  Patching.
  BCL.
  Botulinum toxin.
  Surgical ptosis
  Tarsorrhaphy.

Autologous Serum containing
- Vit A
- Epidermal growth factor
- TGF-β.

- Loose sutures
- Recurrence of dysteophy
- 1° graft failure — Pachy & Specular uscopy
- final Refraction — after sutures removed.

OPD visits
- 2wk × 1mth
- 4wk × 2mth
- 6wk. 3-12mth
- 6-12. — 18-24mth.

In OSSD pt

PED → Storage Medium.
Preservative free medications
& — Trichiasis — cheteolysis ↓ Cryo.
— Dry Eye. ↑ IV&A
— Lagophthalmos

In Glaucoma

↑ IOP — Endothelial cell loss
⊗ — PG Analogue → stimulate graft rejection
Steroids — ↑ Corneal Edema
Miotics → Che Indocyclic
↳ of Aphakes — ↑ chances of tear

Steroid Induced glaucoma.

In Inflammed Eyes

RA, CVD., Perforation, Trauma.

In Infected Eyes

Bacterial keratitis →
Steroid to ↓ risk of Inf
Perf → TA

Fungal
Fil — Non fil
↓ ↓
5% topical Natamycin Ampho B - 0.075-0.15% every hr
200-300mg fluconazole

HSV → Tab Acyclovir 200mg 4TID
BD.

High Risk graft

Make donor tissue less Antigenic

↓

Retreat ⊆ UVB radiation
Use of Anti CD4 recep Ab.

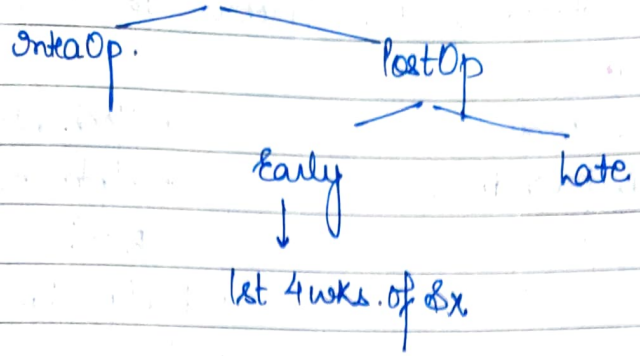
Suppression of host immune response

↳ Topical — steroids
Systemic
- Immunosuppresion

- Cyclosporin
  - Dil 2% /QID
  - Tear 1%
- Azathioprin
- MMF.
- Tacrolimus. 0.3% topical

Complications of Penetrating Keratoplasty

DELTA Pg No.



Intra Op complications

- Poor Anaesthesia & +ve. Viteous Pressure →

⊙

↑ Viteous Pressure
» Triple procedure

℞
- Mech, Medical, Sx method
- digital massage, Super. pinkie ball
- Bef Op Diamox
- i.v | Mannitol.
- Wired Lid Speculum.

else do Ant ½ vitrectomy

2) Scleral perforation during application of fixation sutures
Perforation +nt. Cyclox
Damage to Ciliary Body — Hmrg

3) Improper. keephination
a) Reversed host & donor keephines →
0.5 mm disparity.
Small donor → H_2O tight closure. x possible.
↑ IOP due to tight sutures
Collapse of TM.
Hyperopia.

℞ —) Another graft
) If lens also put compensate for hyperopia
) If only donor cut, use 0.25mm Small keephine

b) Eccentric Host keephination →
↑ Astigmatism.
keephine ⊥ to Cornea. → to prevent sliding & lamellar dissection.
sharp keephine, proper centration
if cut < ⅓ → leave it
> → Larger keephine used.

- Irregular / Oval Keyhination → × use Scleral rings.
- Retained Descemet's Membrane →
  Mainly in thick Corneas — CHED, IK.
  failure to grasp Iris is conclusive sign of presence of retained DM
  IntraOp- Removed. Inject Visco beneath it so that it is elevated
  Post Op → leads to Opacification — confusion & Retro corneal membranes
  do. Nd YAG laser descemetotomy. Use 0.1% Trypan blue.

- Damaged Donor Button →
  × distilled H_2O on trolley
  » Endothelial loss — > Phakic & aphakic.
  Endothelial Iris. Contact during Surgery.
  dropped during transfer.
  ∴ Use Viscoat.

- Inversion of graft → Identified by orientation in the well.

- Excessive bleeding → Excessive Iris manipulation.
  Cautery, Compression & Visco.
  Sponges soaked & Epinephrine 1:1000.
  × Intracameral Epinephrine → CME ∴

- Injury to iris lens diaphragm → Repair with.
  10-0 prolene sutures

Date
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⊙ ICR & Vitreous Prolapse → Ant vitrectomy
Open loop Kelman Multiflex ACIOL. + PI.

⊙ Suture related Complications →
Broken / Loose / Tight Sutures → failure to Bury knots
Care in Continous Suture.

Problem with suturing graft to host → 2nd suture most important

⊙ Iris incarceration → Inadequate healing, low grade uveitis & ↑ graft rejection.

⊙ Shallow AC → floppy iris, CI scars, + Vitreous pressure
use of small graft

⊙ Wound Leak → >> Sutures. If still not ⊥ prolene suture.

⊙ Suprachoroidal Hmg → Uncontrolled bleeding → expulsion of. IOL content.
R/F
Rx PreOp ↓ IOP.
Controlling HTN
Prevent Valsalva during Sx

IntraOp → Occlusion of Corneal opening
Sealing of eye

If Hmg after entering globe – post sclerotomy in IT
temp KPro
I.V Mannitol

Early

Post Op Complications

- Shallow AC & Wound leak → ↓IOP + shallow AC — Wound leak. Seidel's identify it. Prolonged shallow AC. — occurence of 2° glaucoma., Endothelial loss.
  Common causes → Broken, loose, misplaced suture
  Suture track leak : full thickness s. thru. thin, necrotic tissue
  Excesive gap b/t sutures
  Unequal thickness of graft & host.

℞ — Bcsue bandage, BCL, tamponade
⊥ suture to suture track.
give Diamox

- Iris incarceration → PK in Inflamed eye.
  Localized edema, affect Vascularization.

℞ Seal Leakage
Argon LASER Iridoplasty.
Seperate using Visco.

- Wound dehiscence → Early — Thin necrotic recipient bed
  Late — ↑IOP.

Causes — Trauma — Worst Outcome.
DK.
Suture failure.
Sport. Wound seperation

Iris prolapse > 24 hrs — Iris tissue abscision. done.

Date
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⊙ Suture related problems

- Exposed suture/knot – f.b sensation, photophobia, ↑ mucus production, GPC
  - Stimulate Vascularization → ↑ risk of infection
  - Exposed knot – Nidus of infection.
- Tight suture → RED, induced ↑ astigmatism.
- Loose suture → Epithelization – remains exposed Nidus for collection of mucoid & tear debris focus of infection
- Suture related infections – Suture exposure, use of soft CL, topical steroids. Suture abscess
  Debride → Rx. ↓ CS.
- Suture related Immune infiltrates – Immune Rxn. to suture material or Talc

Immune	Infectious
Multiple, small	Solitary
Occurs on host side	Both.
Overlying epithelial defect –	+
↓	↓
↑ CS dose.	Oral CS

- Descemet's Membrane detachment → due to improper graft handling or Trauma.
  - Rx gentle handling, careful instrument manipulation
  - Intracameral air, Visco
    TransCorneal suturing
    Intra Cameral C3F8.

⑥ Epithelial defects → heals by sliding movement
Avg – 4-6 days.

RoF → CSSD
Lid Abnormalities
Infection & Inflammation
Neurogenic
Iatrogenic – Tight sutures
Epitheliotoxic drugs
Damaged donor Epi
BM disorders
Intrinsic epi disorders
Trauma
Poor Nutrition – Vit A def.
Metabolic eye disease – DM.

Serious Consequences → Graft Ulceration.
Stromal Melting
Perforation
graft failure.

Mx

Pre-Op. | Intra-Op. | Post-Op.

Pre-Op → Ensure adequate lid closure
→ Significant stem cell loss – LsC. transplant
→ dry eye – Mx, Punctal Occlusion
→ Herpetic eye – PreOp Oral Acyclovir 400mg BD
Non healing ED.
Surgical incision of V N.

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Intra Op → × tissue ≤ ↑ prolonged preservation time
× Rough area on refford block
× slippage of donor / cornea
✓ BCL or KPro.

Post Op Mx

Eye patch × 24hrs
Preservative free drops
frequent use of Lubricants.
BCL used → ↑ A·B 3-4 hrly
If × heal by 2nd Post Op – Temporary tarsorrhaphy
Iatrogenic Ptosis by Botulinum toxin.
- Autologous Serum to ↑ healing. 20-100%.
- AMT

Thick BM → ↓
- Migration of Epi cells
- Reinforces adhesion of basal epithelial cells
- Promotes Epi differentiation
- × Epi apoptosis

Avascular Stromal Matrix.

- PTK – 1mm, 150-200 pulse ablation at edge of ED.
- Recombinant Egf & fibronectin – Under study.

⊙ Filamentary keratitis – Collection of Mucus & corneal epithelial cells. stain ⊆ Rose Bengal stains.

℞ – Underlying dry eye
Non preserved Lubricants
Topical steroids, NSAIDs
Punctal plugs
Hypertonic Saline.
Mucolytic Agents.
BCL.
Mechanical removal if » f.b sensations.

⊙ 1° graft fail
⊙ graft rejection.
⊙ Hyphaema. → clears spontaneously. Associated ⊆ ↑IOP.

℞ — ß Blocker + CAI
systemic Osmotic agents.
Weak Mydriatics — To prevent Synechiae
Steroid. – To control IO Inflammation

Sx — Clot Irrigation
Use of Anti Coagulants.

⊙ ↑IOP & PBG → factors — Residual Visco in AC.
Uveitis, Hyphaema
Crowding of AC ∠.
PB.
Forward move" of lens Iris diaphragm

Irrigate Visco.
Uveitis — 1% Prednisolone
0.1% Dexa.

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Crowding of ↓ → » common in aphakic keratoplasty when IOL collapses due to lack of lenticular support

Avoid small graft & tight sutures

AC shallow

↓

Siedel neg

Pupillary block. ↑ IOP

Post synechiae
Vitreous protruding
∴ ✗ air to be used in aphakes.

Dilate pupil
PI.

Choroidal detatchment ↓

Flat AC.
Seidel neg.

Do USG B scan

Topical & systemic CS
AC compromised → 48-72hrs OT
Do suprachoroidal drainage.

↓IOP → Possible factors — Wound leak
Iridocyclitis — CS
Cyclodialysis
CD
RD

HSK

S/t 1-15yrs recurrence

HSK.
Classical epi dendrite
Focal involvement
» bt stromal
granular appearance of graft

graft reject"
✓ Khodadoust line seen.

Mx — 3% Acyclovir . 5TID x21d — Epi
↓↓ + CS — steroid
Topical x2wk to prevent recurrence ✓
Oral » effective Val 500mg OD x1yr.

Microbial keratitis 1.76 — 4.9% ed. Png — 11.9%.
in graft — Suture tracks at graft junction.

Post op caused by — Intra Op Contamination
Recurrent Host disease
Poorly preserved donor Material
Change of colour of Media
Used of CL.

Possible risk factors for Post op graft infection

Faulty preservation	Faulty graft	Pre-Existing Ocular Disease
. Contamination of preservation media.	- Sutures related problems	- DED
. Long term preservative media.	- PED.	- HSV
- Lack of asepsis during tissue processing	- Use of CL.	- Chemical burns
	- graft CL	
	- Graft failure	
	- Wound dehiscence.	

Topical steroids — Systemic disease

Endophthalmitis → Dx by clinical signs & USG B scan.
Mx → Vitreous tap

Late Post Op Complications

- Graft Rejection
- IGK — Ant lamellae of graft. ✕ in stroma.
  Interlamellar aggregates of gram +ve cocci
  Deep Viridans
  Mx - Ceftaz + Vanco
  - Sup lamellar keratectomy
  - Disruption of interstromal cystals using Nd Yag LASER.
- Vogts Tavalia Syndrome → Permanent fixed pupil in pt c KeratoConus post PK or DALK.
  Unresponsive to Miotics.
  Severe Ant Segment Ischaemia
  Px. ✕ Atropine.
  ↑ IOP.
  Rx.
  Peripherally painted CL c clear Optic Zone

(#) ⊙ Corneal Membranes →

- Epithelial ingrowth
- Fibrous ingrowth
- Stromal ingrowth
- Ghost Keratopathy

Epithelial ingrowth → Predisposing factors →
Poorly healed Wound
Fistulous tract
W. dehiscence ⊆ Iris incar.
Trauma.
Previous IO Sx.

Epi seeding in AC by :- full thickness suture
Surgical instrument
foreign Body

Epi ingrowth over post surf of cornea, AC ∠, Iris

Cornea result in Endothelial dysfxn, Corneal Edema, hazy graft.

AC ∠ - glaucoma
Iris - Pupillary distortion, Heterochromia, Iritis, Iris Inclusion Cyst.

Dx - Confocal uscopy
Mx - Sx Excisional, IOP↑, 5FU use

Fibrous Ingrowth → Keteo Corneal Memb — White fibrous collagenous tissue invading b/t EM & Endothelial cell layer.

Predispose → graft failure, ↑ Vitreo Corneal Contact
Severe Post op inflammation
Fibrous infetco

Epi in
- Laser ablate Iris. tissue takes place. Identified by white, fluffy lesions
- Others

x take up.

Rx Repeat graft

Stromal Ingrowth → Improper post wound apposition
Stromal fibroblast → PC → cover post surf of graft

Pathology in peripheral part of graft.
↓
Extensive Ingrowth → destroy entire endothelium.
& Repeat graft

Hurricane Keratopathy →
Wheel / Hurricane
↓
» visible ⊆ fluorescein.

Represents migratory pattern of normal epithelial cells
Clockwise due to Ocular electromagnetic fields on migrating epithelial cells.

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Cataract

3 Mech

- Poor surgical Tech
  - Ant Capsular Injury
  - Excesive Iris manipulat°
  - " irrigation
- Altered lens Metabolism
  - Persistent Pupam
  - Hyphaema.
- Toxic
  - Cs
  - Anti CHE.

Rx — Visco - deep AC
Try Triple procedure
Cataract extraction Other. Incision.

Mx

- Post PK Astigmatism
- Glaucoma
- Recurrence of Original Recipient Disorder
  - Stromal dystrophies
    - Granular — 100% at 4yrs.
    - Macular — 5.2%.
    - Lattice — 48%.
  - Reis Buckler's
  - Central Crystalline
  - Post polymorphous D

- Repeat graft
- Superficial Keratectomy

- Disease transmission 4m. donor cornea.
- VR problems — RD.
- Maculopathy → use of NSAIDs
  IVTA

Corneal graft Rejection

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Definition → Irreversible loss of graft clarity.
Graft edema – 2° to Endothelial cell loss
Leq – 1000 cells/mm².
2 pumps in Cornea

1 → ATPase dependent
2 → CA pump.

graft failure
1° Early
2° late

1st Post Op. Week.

1° failure → graft which never clears remaining thickened.
postoperatively
Due to immunogenic Mech.
Poor eye banking, Rx trauma

2° gf. → that has functioned in immediate Post op. period. Unless told its 2° gf always.
Allogenic graft rejection is type of it

Causes → Loss of endothelial cells — Aphakia
Old ACIOL, Uncontrolled IOP

Types of graft Rejection

Donor epithelium persist upto 15mth post graft — hence rejection can occur any time during this period.

Layer wise rejection →

Epithelial

↑ line of abn epithelium
↓
staining c fl or rose bengal

Subepithelial

Subepi infiltrates reminiscent of Adenoviral inf (Krachmer spots) on donor ⊙

Deeper Edema
Infiltrative Opacification
full thickness Corneal haze.
Stromal hyperaemia

⊙ Graft rejection manifesting as Ant stromal Nummular inflammatory lesions in donor & EKC

Post Lamellar Keratoplasty

We do c aim of endothelium intact. ↓ chances of rejection &

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Stromal

Deeper stage

Chronic

Hyperacute
↓
Endothelial rejection.

Stromal keratocytes persist indefinitely
↓
∴ stromal dystrophy occurs.

Endothelial

Linear pattern of KPs

Rhododaust line ⊙
Stromal edema
» Aggressive & ass ≤ AC inflammat° ± Hypopyon
Commonest.

⊙ line of KPs across the endothelium representing the advancing front of rejection.

Old KPs
Pigmented.
Sharper borders.

Recent (reject°)
↓
Acute fluffy edged ppt

Use — Pachymeters

Prevention of graft rejection

- Careful case selection → little benefit Pro
  Unilateral disease

  Auto Corneal transplants
  Always think of other options first.

- Identifying High risk Corneal grafts →
  Rf :-
  - Inflammation before or at time of grafting
  - Recepient Corneal NV at
    ∝ No. of Quad
  - H/o ↑ IOP in grafted eye.
  - No. of previously failed grafts.
  - Past infection
  - Larger graft.

- Topical Cortico-steroids →
  Ix → Past HSV
  Other Infection
  Corneal Ulcers
  Thinning
  Previous graft failure.

Long term Ix → High risk of graft failure
>1 rejection episode

Sutures removal post graft failure ∴
↑ or start CS

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Tissue Matching → CCTs demonstrate significant ↓ freq of allogenic rejection in high risk cases when ABO Bld gp is matched.

Antiviral Rx: Where there is a HSV disease → HSDs study : Tab Acyclovir 400mg BD.

Clinical Presentation

Symptoms → Blurred Vision • pain • irritation
Red eye • discomfort • Photophobia

Rejection occurs in 1st Post op year.

Signs In 1st yr — Avg 3mths post Sx

3 Types

Epi Stromal Endo.

Treatment

Early recognition → Explain the pt

Min % of Allogenic graft rejection → Topical cs
> Acetate — Lipophilic Base/Vehicle

02d Prednisolone acetate 1% 1drop/day, N × 02d
↓
25d. 1drop/day, ↓ overnight
↓
Oint HS (Resolving)
↓
BID × daily × 1 mth

Role of Oral cs & steroid sparing agents →
» Inflammation
failure > significant.
KC pt ⊆ history of atopy — Blepharokeratitis

Dod

- Graft failure → x Inflamm like Rejection
  at ℞ first as Rejection.

- Loose Suture & 2° Microbial Keratitis → Send for culture
  continue Cs as gram +ve Cocci. x. adverse response to Cs

- Microbial Keratitis → PCk, Candida.
  respond badly to Cs.
  ℞ + adequate Cs to ℞ rejection episode
  causing ↑ dose of Cs. x potentiate Infection

- HSV Keratitis → Kls not confined to graft.
  ℞ c Oral Acyclovir.

- VZV Inflammation → Stromal swelling
  ↑ AC Inflammation.

- Epithelial downgrowth → distinguish by LASER.

- Post ℞ Inflammation →

Pathogenesis graft failure

Date
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Immune Priviledge

AC Cornea

AC →

Immune priveledged organ – Eye hair follicle
brain
pregnant uterus

Immunosuppresive in AC

- TGF β
- α MSH
- mΦ MIF
- CGRP
- Somatostatin
- Complement Regulatory protein.
- Soluble FasL
- VIP

Apoptosis of immune cells infiltrating Eye

TRAIL → Tumour Necrosis factor rel apoptosis inducing ligand
FasL

ACAID

Anterior Chamber associated Immune deviation
4 organs

- Eye
- Thymus
- Spleen
- CNS

⇒ Long term survival of corneal allografts is co-related with development of ACAID to donor histo compatibility antigens expressed on corneal transplant.

Cornea

a) Central portion of cornea — devoid of mature MHC, class II, +ve APC (Langerhan cells)

b) graft's capacity to induce ACAIS
↳ by IC injection of donor cells done, graft survival is enhanced

c) Capacity of corneal graft to disarm Immune effector elements that arise at graft/host Interface.
↳ FasL & TRAIL expression

d) Cornea expess cell membeane bound regulatory proteins that disable elements of complement cascade & prevent activity of complement fixing Ab directed at corneal transplant.

Efferent arm

Efferent arm

Corneal Graft Astigmatism

>5D astigmatism → ↓ Uncorrected VA.

Regular | Irregular

Causes

Pre-Op | Intra Op. | Post Op

Pre-Op:
- Host: Cornea (scarring, vascularization)
- Donor: - Size, - Thickness, - Pre-existing astigmatism

Intra Op.:
- Wound edge profile
- Trephination size.
- Tissue distribution
- Suture related factors
- Other factors

Post Op:
- Suture loosening
- >> Sectoral Vasc + path
- Cheese wiring

Wound edge profile & Trephination shape →

- use of lid speculum, SR sutures, globe support.
- Tilting of trephine → Elliptical / Round.

∴ use Hessberg Barron, Hanna, Krumeich] Trephine.

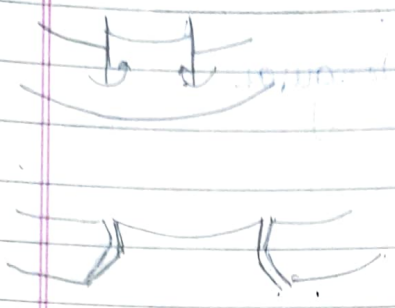
Tissue distribution → Uneven: Cardinal sutures.

↓ by larger donor size (7.5 mm)
Oversizing only by 0.25 - 0.5 mm.

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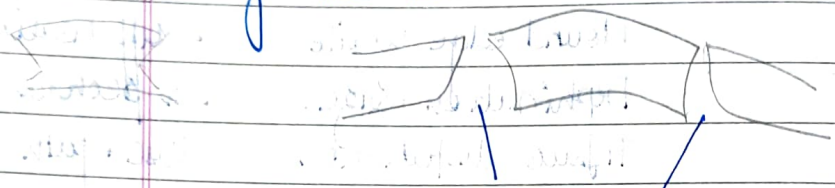
Donor

Host



= keephune size
Mushroom topped donor
undercutting host bed

> keephune size
>> Posterically



Post Wound gape
Tightened suture

∴ ½ keephune → Complete ≤ Scissors
to produce straight wound edge

- 95% depth suture.
- Oversizing 0.25 - 0.5mm

- Wound profile asymmetry →
- Other suture related factors → Tight suture induce focal steepening in axis of suture
  Wound gape 90° away | 4m suture.
- Loose suture — flattening in their meridian
- Longer bites → ↓ astigmatism

Difference b/t suture depth → Cause sectoral over-ride of graft vs Host : 95% depth.

Other factors → Tilted IOL
Toric IOL
Sectoral sutured PCIOL → distort the globe.

Surgical Tech for prevention of Post Op Astigmatism.

Interrupted Single Running (=) Combined Interrupted & Running → Astigmatic Outcome.

✓ can replace Coutin – distribute Centrifugal forces more evenly.

x for. TPK or Technic

Assessment of Post PKP Astigmatism.
Manifest refraction.
Retinoscopy.
keratometry
Placido Ring Keratoscopy.
Computerized Video keratoscopy (CVK)

Placido : Qualitative
Ghost axis → steep axis ○ elliptical reflex seen

∝ Tight suture include → •) Peripheral indentation of keratoscope rings
•) Individual keratoscope rings b/t tight sutures.
•) Decentration of corneal apex away frm tight suture.

CVK » Quantitative.

Management

Suture agustment & selective suture removal

Spectacle

CL

Surgical

Astigmatic keratotomy

Wedge excision

Compression

Relaxing incisio

Corneal segeafting

Excimer LASER Sx.

Toric IOL.

Nov 8x

Spectacles & CL

4D by Spectacles
↓
> then Oblate (Reverse Gyroscopy)
RGPs

Selective Suture Removal → Only Interrupted one.

POD 1 → If Causing Wound leak.

Else POM → 6 wk 25-27G Needle
℞ A·B & Anti reject° ℞ for 1wk.

Adjustment of Continous Suture 3-6 wks Post op.

Req — 4D Astigmatism.
CWK / Topography
Topical anaesthetic

Break epithelium.
Mobilize suture.
feed suture around blue to red meridian

Surgical Mx

- Relaxation → flatten steep meridian → Relaxing incisions
  - Arcuate keratotomy
- Compression → steepen flat meridian → Compression Sutures
  - Wedge Excision

Astigmatic keratotomy

- ½ thickness incisions
- Once all sutures removed
- ✕ correct spherical equivalent

If significant Myopic SEQ

- Refractive LASER procedure
- ✕ PK → Planned Refractive LASER procedure

Manual / Femto-assisted.

Manual

Under Operating Microscope
slit lamp.

Req
4D Astig
RK Corneal Marker.
USG Pachymeter.
Microkeratome Diamond Knife.

Tech

- Pachy — 1mm inside.
  Gr Ixn at steep axis of cornea

- Depth of blade - 60-75%.
  of thinnest pachy reading

- 60° arc. ⊥ to graft suf
  1mm inside Gr Ixn

( )

2nd incision. 180° to 1st is req.

Manna. Accitome » predictable
Compression Suture / across
Gr Ixn at 90°

Rx - Anti Rejection | 1*/wk
A-B Rx

femto assisted.

Studies req.

- Compression Sutures
  across limbus to steepen flat meridian

  Req — 3-4D of astigmatism
  Stable refraction
  10-0 Nylon.

  Suture placed over flatter meridian

- Wedge Excision — >° of Astigmatism.
  1mm Wedge corrects 8D.

  ✗ → Slow recovery
  Variable Astig Correction.

  Manual — Femtosecond

  Paracentesis
  depth upto DM

- Refractive LASER Sx → Combined Myopia + Astig
  after grafting.
  Residual. Unwanted Myopic SE.

  xPRK — as Scarring
  LASIK — ✓

- x Toric IOL if Cataract Sx planned.

Epikeratoplasty

Placement of a human donor lenticule or synthetic material on Bowman's Memb in order to change the refractive power of cornea.

Onlay lamellar K. / Living Contact Lens

Indications → • Aphakia • Myopia • Keratoconus
• TMD • PMD • Keratoglobus • Post traumatic ectasia
• Corneal Melting

Suitable for K →
BCVA — 6/60, No apical scarring, Intolerant to CL

KG → 1mm larger Cs button.

Surgical Tech

Separation of Recepient Cornea →

De-epithelialization → 4% cocain soaked sponge
x » periphery.

Annular keratechomy → 0.5mm wide & 0.3mm deep.
If large cone 8.5mm - 9mm keephine used.

8.5mm keephine → 1-3mm lamellar dissection
0.3mm deep incision

Procurement of Donor Lenticule → 0.5 mm oversized

Manual dissection of donor Lenticule

✓ → ↓ loss of keratocytes

x → ↓ shorter shelf life.

Cornea
↓
King's clamp
↓
Castroviejo Trephine
0.3mm depth

whole globe
↓
Hessberg Barron Trephine

↓
Create peripheral Ring by dissection 0.2mm annulus all around
↓
Easily tucked into keratectomy of host Bed.

Suturing →
10-0 Nylon.
Bite on corneal side = 0.5 mm host side = 1 mm
In KC — tight sutures — flattens Cornea
Knots buried in Recepient tissue.

TPK → after 360° peritomy — graft is sutured.

Post op regimen
AB + steroids.
Patching until epithelization occur.

✓

- All advantage of LK
- ↓ Incision req in central host C
- ↓ Astig
- Avoid vision threatening complications
- ✗ ↑ risk of future PK.

✗

- Poor predictability to achieve Emmetropia
- Poor Quality of vision & Visual outcome.

Complications

Post op —) delayed epithelization — >> lyophilized C. as ✗ viable keratocytes. Rx ⊆ tear substitute & BCL.

) Dehiscence of graft
) Microbial keratitis
) Keratolysis of Lenticule.

) Interface Haze →

↑ CCT.

Stress on Host Endothelium

slow repopulation of donor tissue.

Mild → Optical correction ⊆ CL

Significant → Rx Intervention

Graft problems
) Epithelial Ingrowth

- Irregular Astigmatism — due to Wrinkling of BM
  selective Rx removal

- Hoover's.
- Rel Hypesthesia

Synthetic Epi

Protein coated Hydrogel Epi Lenticules

Collagen Synthetic Epi Lenticules

Manual Lamellar Keratoplasty

Replace only part of Cornea that is diseased & leave receptent's Normal anatomic layers intact.

Lamellar (Types)

- Ant (ALK)
  - Onlay → EpiKP
  - Inlay → S, B, Epi
- Deep (DLK) → DM Intact → KC, Scars
- Deep Ant (DALK) → Upto Endothelium level → DM ✗

IX

Optical

- Peiss Buckle's
- Salzmann
- KC
- Granular D
- Band Shaped K
- Superficial corneal opacification.

Tectonic

- Dermoid
- TMD
- Mooren
- PMD
- KC

Therapeutic

- Recurrent Pterygium
- CIN
- Epithelioma.

Date
DELTA Pg No.

Developed	Developing
CD	Chemical injury
Aniridia keratopathy	Trachomatous K.
Cscars	Keloids
Keratoconus	

Criteria
- Healthy host Ocular Suface
- Optimum Endothelial fxn.
- Corneal Opacity — DM spared
- Distorted C. suface — × allowing CL fitting.

CI
- HSK
- HZO.
- Chemical & radiation injuries
- SJS
- OCP

LK
- Extra Ocular procedure
- ↓ chance of rejection
- ↓ stringent Quality of donor
- × need to be fresh.

Can be used for eccentric Corneal thinning.

PK
- × Intra Ocular complications

KC
- ✓ better VA
- » chances of rejection

✓

EO procedure
↓ potential for IO complications
↓ Astigmatism
↓ chances of graft rejection
↓ Wound dehiscence
Donor Quality criteria ↓ stringent.
× req of future PK.

×

- Tech difficult
- Interface scarring
- Epi defects
- ↓ Optimal visual results

Pre-Op Evaluation

- VA.
- Gross Ocular Exam – Tear film, Lash abn.
- Slit lamp Biomicroscopy
- Pachymetry → In all 4 meridians
- computerized Corneal Maps
- Specular Micro Scopy

Surgical Tech

Cut recepient first → else full thickness graft.
» 1 donor eye available
0.25- 0.5 mm larger graft
Graft of uniform thickness or slightly ↑
Margin should match.

Graft host disparity → 8-9mm bed
0.25mm - 0.5mm large.

steroid

Separation of recepient Cornea →

½ Thickness cut
lamellar dissection

- Trephination & Circular trephine.
  - 0.2 - 0.4mm depth
  - 90° → 60µ
  - 360° — 240µ.
- Manual free Hand dissection.
  - ↓
  - Cornea ≤ Irregular thickness
- Automated Microkeratomes
- Lamellar dissection of recepient Bed.
  - Non Mechanical Excimer laser Trephination

Lamellar dissection of recepient Bed →

Deep > Sup. i.e Jxn Ant 1/3 to 2/3

- 1/3
  - ↓
  - Short
  - closely interwined.
- 2/3
  - ↓
  - Loosely arranged
  - Dissection easy, regular, smooth
  - Longer
  - easier to perform

-) Tooke's knife — Pocket
-) Lamellar dissectors
-) Keep surface dry — Better visualize
-) Cut ≤ CS scissor
-) Avoid closed dissection
-) In KC — 120° Inferior peripheral cornea — careful
- Irrigate steams — fluffy.
  - → Use Hallbauer cutting tech.
  - pull steep surf up ≤ forces

Modification in tech of Lamellar dissection of Host tissue
To avoid perforation

- Air Injection →
- Hydrodelamination → Saline goes into stromal fibres
  Used for thick host corneas in KC & KG
- Viscoelastic Injection →
- Divide & Conquer Tech → prevent high astigmatism.
- ~~Harvesting of donor Lenticule →~~

Harvesting of donor Lenticule

- Whole eye.
- CS Caps
  - Larger rim
  - Kling's Clamp
  - fix → 3pt fixatn tech.
    - Stabilizing Cap to fabric covered glass ball
- Be Carved Lyophilized tissue
  - Cryolathe has slow visual recovery
  - Lyophilized are Immunogenic due to absence of active keratocytes

Date
DELTA Pg No.

Tech to harvest graft from donor tissue

- Open Tech
- Closed Tech.
- Use of Microkeratomes
- Full thickness graft

Open Tech / Closed Tech → Corneal edge is not lifted.

Full thickness graft → Take full thick graft ↓ Cut ↓ Opp side start removing em

» KC. ← Severely thinned Corneas Sup. Scaling.

Free Hand dissection — Non Circular grafts

Suturing of the graft

- Interrupted sutures
  - Tight sutures for better apposition.
  - 2mm. Refill to tuck in.
  - In KC, KC → ½ removal of Ag may be necessary.
  - Keep lint away
  - Thorough wash } Interface clear

Post Op Care

Medication

- 4 o B.
- CB
- Lubricants — 1 drop QID.
- Lens for Epithelial defect heal

Suture removal

Removed as vessels start bridging
@ 6 mths later

Complications of Lamellar Keratoplasty

Date 108

Intra Op.

•) Perforation of DM
dx by Aq fluid on lamellar bed ∴ always keep dey.

Can occur during trephination or Keratotomy

- During trephination
  - Matteers suture
    - Post prone dx Smith
      - Let DM heel
  - Small
    - Half dx
      - Matteers dx
    - Dissection at site 180°
  - Medium
    - Start 4m other site in different plane.
  - Large
    - stop.
- Lamellar Dissection
- Keratotomy incision

Post-Op.

•) Double AC — R/ by draining AC 4m created chambers

•) Folds in DM
•) Delayed epithelization
•) Stromal Melting
•) Microbial keratitis
•) Epithelial proliferation & ingrowth
• Astigmatism
• Interface Scarring
• Recurrence of Host pathology
• Suboptimal visual acuity.

Automated Lamellar Keratoplasty

DELTA Pg No.

Explain how microkeratome works.

Ix

CI.

Pr-Op.

Op
- Preparation of Recepient Bed
- Donor Lenticule
- Apposition.

femto assisted

Advantage.

complication

Outcome.

DALK

- Melle's Tech.
- Big Bubble
- Double Bubble.

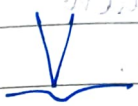
Melles Tech

Optical Visualization of dissection depth during Surgery →

a) Mirror effect

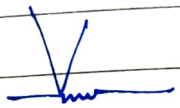


b) Indentation effect.



Non incised stroma.

c) Folding effect.



d) Moon Surface effect — look like guttata when × present

- Manual deep stromal dissection through scleral tunnel incision

- Why air bubble → a) Specular light reflex
  b) Small folds easily seen
  c) Mucoperforatn easily noticed
  d) Self sealing perforation.

Visco-Elastic — Pseudo Ant chamber.

Big Bubble Tech

Date 1/10
DELTA Pg No.

Deep stromal dissections
- Manually
- Microkeratome
- femtosecond

Big Bubble Tech

Ix — where endothelium is healthy
- Ectatic Corneal Disease
  - KC
  - PMD
  - KC
  - keratectasia
- stromal corneal opacities / scar sparing DM
- Corneal dystrophies involving Ant / deep stroma.

CI
- Corneal conditions w diseased endothelium.
- Pre-Existing rupture in DM
- Deep scars
- Macular Corneal Dystrophy

Recipient dissection
for separation — Air bubble used.
Hidden — A circular white line out just inside limbus.
- Sudden ↑ in anterior curvature of stromal bed.

? to confirm if bubble formed → if small bubbles stay in periphery
- Presence of extra light reflexes deep in AC.

Donor preparation — apply BCL

Double Bubble Tech.

DALK → KC.

↓ Melles — ∝ Mirror reflex in AC

↓ Pechila — Intrastromal air injection

↓ Anwar — 60-70% dissect^{n} before Big bubble

↓ Big Bubble — Complete dissection.

↓ Parthasarathy — shifting bubble sign.

↓ Double Bubble — Small bubble centre to periphery as soon as big bubble injected.

Ix KC.
Corneal stromal dystrophies.
Corneal scars sparing DM.

Surgical Tech Hive Speculum.

1st bubble — Air 3-4ml injected into AC

2nd bubble — inject air in stroma using 26g needle — Supra descemet space — 2nd air bubble.

Confirmat^{n} of big bubble formation → Small bubble in periphery. Debulk Ant 2/3 corneal stroma. Then remove air.
Peripheral bubbles come in centre
Inject Vis Co.
Post stroma cut in 4 parts & seperated

Date 11

DELTA Pg No.

Separation of recipient — As usual

Post op

Follow Up.

Suture removal

Complications

Intra Op.

- Failure of big bubble formation.
- Perforation of DM.

Post Op.

- formation of Double AC
- Corneal stromal graft rejection.

DALK Bubble

Type 1

Starts from Centre

Circumferential to periphery

8-9.5mm

DL & Post Stroma

DM peel.

Bubble intact

Surface Rough

Type 2

periphery

10-12mm

DM & DL

deflate

Smooth

Tuck in Lamellar KP

Date
DELTA Pg No.

1) ~~Manual~~ Jx → Ectatic disorders
KC.

- Severe KC ± involvement of peripheral Cornea
- Severe PMD
- KC + PMD
- Peripheral progression of KP post PK.

Prepare host bed → 8.5–9mm 50% depth keephune → Intrastromal pocket

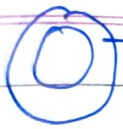
Preparation of graft

Ant. — Post.

Ant.: 8.5–9mm 300mm depth → Lamellar dissect^n till limbus. → But Excise Sup layer of keephune → Punch Endo side ≤ 11-12 mm keephune → Trypan blue – remove DM.

Post.: 11-12mm keephune → Remove epi → Remove 3mm ellipse of tissue circumferential → Create 3mm flange

→ fixation of graft.





Snf Tuck for PMD.

DSAEK

Date 1/3
DELTA Pg No

EK
Rapid
Refractive Neutral
structural integrating of eye.

PK
Prolonged recovery
↑ Astigmatic errors
Permanent weakening of eye

DLEK
↓
Descemetorrhexis

DSEK
↓
Scoring DM.

Ix
Rieh's
Bullous KP
ICE related Edema
EK after PK

Surgical Tech

Donor
- Manually
- Microkeratome
- Predissected donor graft 4m Eye bank
- femto assisted.

Manually — 16-17mm Rim. → x edge defects.
Microkeratome — Moria.

Decide donor Cut ∝ White to white dia.
9mm — 11.75 "
8.5 — if <.
<< . . . of PAS or shallow AC.

Recepient preparation = Temporal incision as sup
Incision — Conj for glaucoma.

In ↓ failed PK — retain DM → as maintain strength

If decentered graft — nudge the graft into positi
by LPSIK rollers

Post op Care

Refractive Outcomes → PK → ↑ 3-4D mean refractive cylinder

Sutureless DSAEK

Ix — Fuch's
ASK, PSK
failed graft

PreOp — H/O
Ocular surface
Corneal Topo.
Special — ASOCT

Rx — Anaesthesia
Preparation of pt.
donor tissue prep

Recipient Rep — Creation of Surgical Hounds
- Stripping of DM
- Creation of stromal fenestration.
- Insertion of donor Lenticule using Busin glide
- Centration of donor Lenticule.
- Drainage of interface fluid.

Post op Mx

Post Complications

Intra Op
- Repeat prolapse of iris through main Hound.

Post Op
- Graft decentration
- 1° graft failure
- Pupillary block
- Interface fluid & graft dislocation.
- Graft Rejection.

DSEK Triple

Date 115
DELTA Pg No.

Ix → Fuch's → failed graft → Viral Endothelitis

Pre-Op Work Up → Ocular Exam.
Surface.
Corneal Topography
Special Investigation.

Selection of Lens → keep in mind Hyperopic shift.

Minus lens effect of lenticule
↓
Concave Nature of Lenticule
Thin in centre, thicker in periphery.

Due to cutting by automated keratome.

Swelling of peripheral stroma.

↓

Marked is no protrusion of lens through rhexis.

Separation of Donor Lenticule →
In case of regraft, use donor smaller than past dia of previous graft to eliminate problems of graft dislocation that can be caused by irregularities of posterior profile of previous host graft jxn.

Surgical Steps →
- Creation of Wounds
- Phaco Cataract Sx
- Removal of Host DM
- Construction of Pupil
- Creation of Stab Wounds

Use Cohesive → easier to remove after Sx & does not displace lenticule.

- Donor Lenticule Transplantation.

Post op. Cx

Occurence of ruptured of Post capsule

DMEK

Date 116
DELTA Pg No.

DSEK → Post lamella of stroma (100-200μ)

✓ good visual recovery.

✗ Stromal Interface haze.

Ix for DMEK →
- PBK, ABK
- Fuch's
- PPCD.
- ICE.
- CHED
- failed DSEK/DMEK
- Endothelial decompen.
- " failure.

Surgical Tech — Same.

PK - Triple

Date 11/7
DELTA Pg No.

- Fuch's dystrophy
  - Endothelial count < 1000/mm².
  - CT > 0.62 - 0.65 mm.
  - ↑nt of corneal changes on slit lamp.
  - decompensated cornea
- Herpetic keratitis
- Bacterial "
- Chemical Burns
- Trauma
- Corneal Opacity in elderly pt.

C/I Corneal Ulcers, IK ⊆ melting cornea, OCP.

Pre-Op Eval — IOP status & Retinal evaluation.

IOL power Calculations → Use Keratometer
Avg K = 43.5D.
Surgeon's Avg K readings
Hoffer Tech & AL.

Surgical Tech →

ECCE + PK.
PK ↷ Phaco
Temporary graft
" KPRO.

Donor Cornea Trephinat"
Recepient " "
ECCE.
Capsulotomy & nucleus removal

- Irrigation & Aspiration of Cortical matter.
- Post IOL insertion.
- Inadvertent PCR.

Suturing of graft

Adjustment of Suture Tension

Post op Care

IK for ABK & PBK.

Date 78
DELTA Pg No.

Be-Op
- History
Exam of Ant seg
Evaluation of IOL.
IOL power Calculations - AvK - 43.5D
L of 4m Normal eye then + 2D.

ACIOL Calculation → New ACIOL = WtoW + 1mm
Power + Earlier records - 1.5D
L Iris plane style - 2.5D

Retinal Evaluation - RD., CME do usg B scan
L Do Macular fxn test later

Surgical Tech - give Mannitol 1-2g/kg B.Wt. 20-30min before in order to detumgisate the viteous & make iris diaphragm fall back.

In aphake use flieeinga rings.

Large size graft so that > endothelial cells r available.

Hyaloid face intact

Aphakia
flexible Open loop. AC - IOL
3pt or Quadri flex.
fixation lens

Loose Viteous in AC.
If r removed :-
- Viteous incarceration in Wound
- Contact ⊆ Endothelium
- Poor prognosis for graft clarity

Do Ant Vitrectomy.

Pseudo phakia
style of Lenses
Ant Vite after removal of lens
- Iris plane lenses
- closed loop ACIOLs are removed

- Pupilloplasty — Purse string sutures.
- IOL Implantation — Recommendation is replace IOL

PC
- Intact
- Absent / Large tear
  - Synechiae / glaucoma
    - Mild / Moderate.
      - Multiflex ACIOL.
    - Mod / Severe
      - ~~Mod - Severe~~.
      - Sutured PC-IOL.

	Flexible Open Loop ACIOL	Iris Sutured PC-IOL	PC-IOL in Ciliary Sulcus	Sclera fixated PC-IOL
Intro	Kelman style, 1 piece Open loop PMMA. ACIOL	Suturing PCIOL to post of Iris through limbal incision.	If remnants of PCR, zonnuling rings ↓ Implantation of PCIOL into ciliary sulcus possible.	Optic - 6.5-7mm. dia - 12-12.5 mm. SFIOL — Trans-scleral glued — Intra scleral.
Adv	Intractable glaucoma, PAS ≥ 3 clock hrs, Insufficient Iris tissue. Easy ↓ Stds Manipulat^n	• Avoidance of AC structure • IOL closer to nodal pt of eye.	✓ → ↓ demanding tech • Less surgical time • IOL close to Nodal pt • Least Complicated • ✗ ACIOL effects on AC	✓ → Post location limits Endothelial damage •) Lack of Iris sutures allow full pupillary dilation.
Disadv	✗ Suturing loss IOL fixat^n Precludes Vitrectomy ↓ intraOp time in any eye	✗ » uveal contact ∴ ↑ Suture induced uveitis Iris atrophy & possible dislocat^n of IOL. •) Insufficient iris does not support •) Vitrectomy req in all cases •) Elliptical dilat^n of pupil ≤ Iris sutures.		✗ → Tech difficult » intraOp Manipulation Longer Sx time. ↑ VH, RD, Suture Nick, Endoph. Lens. decentration & tilt
Tech	Progressive endothelial loss Develop^n of synechiae & 2° glaucoma	Using prolene sutures.		AO interno ↓ 10-0 prolene straight 26G AO externo ↓ 10-0 prolene straight 26G
	Constrict pupil ↓ Inject Visco. ↓ Put IOL ↓ P/			

Paediatric ~~Cataract~~ KP

Date / DELTA Pg No.

- femto-assisted PK in femto Book.

Pre-Op → For glaucoma start Xalatan or Trusopt.
or Oral Diamox

× Alphagan → causes pulmonary side effects in Infants

Ix →

- Congenital
  - Retro Anomaly
  - Sclero Cornea.
  - Corneal Dermoids
  - CHED
  - PPD.
  - CHSD.
  - MPS
- Acquired
  - Non Traumatic
    - HSK
    - KC
    - BK.
    - NK, IK., fK.
    - SJS
  - Traumatic
    - Birth Trauma.
    - C. cs laceration.
    - Non penetrating inj c/ scar.

Timings of Sx

- EUA — 3-6 wk of age.
- Corneal Transplant = 8-12 wk.
- If Bil
  - ↓ 1st Sx — 2-3 mth
  - ↓ 4wk later
  - 2nd eye.

Surgical Tech

give Mannitol

4-9 yrs

As < 4yrs — steepness & flacidity makes it very difficult to manipulate in OT.

Break adhesions by cyclodialysis spatula

To control bleeding →
a) Healon
b) Topical Epinepheine drops
c) Gentle Pressure
d) MicroCautery.

Gradual severe bulging.
↓
Done over Visco. under. Root (cut 270°)

Rapid & Immediate bulging
↓
Open each Quad (1by1) & tacked down ⊆ 7-0 Silk sutures.

↓

If along ⊆ Cataract Sx add 2cc of Heparin in BSS bottle + Epinepheine.

Concomitant Sx

Concomitant retinal Sx.

↓ PI

↓ Tightening the Iris diaphragm

↓ Pupilloplasty

Post Op Care

EUA.

If Vaccinated then ↑ steroid dose. & avoid. Vaccination.

Alternatives → Optical iridectomy, Rotating keratoplasty.

Optical Correction & Amblyopia Rx

(*) Aphakic Distant Correct^{n} = 63.7 − (2.28 × AL(mm)) − L + 2.50D for Near

∴ Bifocal glasses

↓

Contact Lens

Autokeratoplasty

Type of Sx which uses pt own cornea for purpose of reshearion of vision

Types

- Contralateral AK.
  - Corneal path
  - Blind
    - Post Seg
    - ON pathology
- Rotational AK
  - ↓
  - Sx rotated.

Contralateral AK

- Donor.
  - NPL
  - clear Cornea ≤ cut synechiae
  - Assess IOP
  - Specular Count
  - Videokerato geaphy
  - VER.
- Host
  - Thickness assessed using US Pachymetry
  - Iris & lens status examine

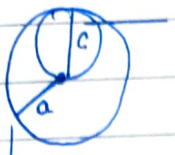
Sx Tech

a) Give Mannitol.

b) Step I (Host Eye) → 0.25mm larger keephne

c) Put back diseased cornea — right sutures as 0.25mm undersized.

Rotational AK



dia of clear cornea.

edge of circle to geometric centre.

+ve — Opacity involves centre of cornea

-ve " ⊆ in largest area of clear cornea

Req. keyhole size = 1.5 × dia of largest circle + shortest distance from circle to corneal centre.

- pt free from risk of graft rejection.
- No waiting list

GA.

Astigmatism.

Therapeutic PK

Date
DELTA Pg No.

Purpose → • Restore structural Integrity of eye
• Resolve infectious Keratitis which is refractory to medical therapy

Ix → – Risk of Corneal perforation & scleral extension.
– Bacterial Keratitis
– fungal Keratitis – f. has teoparn for DM.
– Acanthamoeba K.
– Herpetic K.
– Persistent epithelial defects & sterile Melts.

↓
Rx Surgical Evaluation

Anti Microbial Rx

Donor Material → Larger graft size

Surgical Tech. → 0.25 - 0.5mm disparity
Avoid pressure on the globe.
Interrupted sutures — cheese wiring
Send graft for HPE.

Post Op Mx. → • Eradicate remnants of Infection - all A·B till Epithelial defect heals ✓
• Preservative free A·B & lubricants
• Corticosteroids usage
• IOP Control.

Gunderson Flap

Date
DELTA Pg No.

Def — creating thin Conj flap devoid of Tenon's fascia

Purpose
- Temp. → Optical rehab by PK
- Permanent → Certain Nonhealing Chronic conditions.

Other types of flap →
- Total → Gunderson flap
- Thick flap → Tenon → Stromal loss
- Partial → Racquet flap.

Gunderson used thick flap for. Bullous Keratopathy.

Mech of Action → heals by Refractory ulcers & Necrotic areas / Scar formation

Thin flap — Protection from tears & Irritants / provide blood factors frm Conj Vessels
↓ inflammation, early healing & Wound repair
Tectonic support also — if Tenon's included

Flaps — helps to restore intact epithelium. / Improve tear film.

- PBK — Exposed Corneal N — alleviate pain
- In Severe herpetic stromal Necrosis — Unresponsive to
  ↓
  Conj flap effective means of controlling inflammato
  disease process
- Neuroparalytic K.

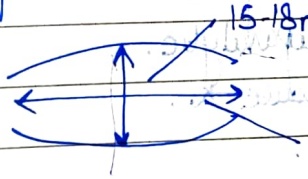
(X) → Neutrophil recruitment.
Liberation of Collagenases.

↑ Vascularized flt ameliorate these effects

Rx →
- Refractory Infectious Ulcer
- Herpetic Keratitis
- fungal keratitis
- Bacterial
- Parasitic
- OSSD & PED
- Neurotrophic Ulcer
- PUK.
- Mooren's
- Exposure Keratopathy
- KCS
- Tectonic Support.

Disadvantages → Inability to visualize details of cornea & AC.
- Persistence of infection
- Rel large area of healthy cay is required.
- Removal of limbal epithelium — require healthy Cay if ~~next~~ subsequent flap ?

Surgical Tech → Scrape off Epithelium
↓
Sup keratectomy done if req
↓
360° complete peritomy done.
↓
Sup bridle rectus suture applied



flap taken.

Pull it down & suture with 10-0 Nylon.

Complications → Button Hole.
Flap Retraction.
Epithelial Cyst formation.
Ptosis
Recurrence ⊆ of ⊆out erosion.

Modification of Tech →

Thicker flap · Conj flap. Mucous membs · AMT · BCL

a) Thicker flap → ✓

Prevent tissue lysis
Avoid adhesion
Scleral lysis

Conj flaps

(−) Obtund view
Suboptimal drug penetration

(+) Smooth surf
Tectonic supp
Nutrition

Available Option.
- Hydrophilic BCL
- TA
- » potent Antimicrobial agent
- Collagen Shield
- AMT

Ix
Neurotrophic CU.
Neuroparalytic.
Exposure K.
PUK.

CI.
- C. pen
- Infectious CU

Types — Total
Partial

Advancement flap
Ix — Limbal/Paralimbal
Cover peripheral patch. graft & Sclerocorneal g
✗ Retract.
Gape over period of time

Single pedicle flap (Racquet flap)
Ix Peripheral & paracentral
✓ (✗ Retract°)

Bipedicle flap (Bucket handle flap)
- Paracentral
- limbal Corneal lesion

Width = 1·3 1·5
sutures

Special Tech of Corneal grafting

Tectonic patch grafts | Keratolimbal grafts | Sclereoplasty

Tectonic Patch Grafts

- Lesions too large to be treated ⊆ tissue adhesive & small to avoid PK
  » peripheral corneal lesions

Lamellar | Full thickness

» Reinforcing thin, neovascularized stroma ⊆ or ⊆ out descemetocoele

Long standing ulcer perforation.

- Acutely inflamed eye
- Interim procedure to stabilize eye

Severe corneal Melts.

Patho → a) inflammatory dis. (Collagenolytic activity) —

Remove area | Provide Support

b) Reconstructive lamellar patch graft — Corneal ectasia descemetocoele, Dermoid excision

c) Scleral patch grafts — Scleromalacia perforans Pterygium Excision

Date
DELTA Pg No

Ix → Corneal patch graft → Corneal perf not amenable to closure

C TA
- Descemetocoele ± Impending Corneal perf.
- C. perf > 2mm < 5mm
- Chronic Non healing C. Ulceration
- Traumatic inseparable C. tissue loss
- C. Ectasia
- Post Corneal Dermoid Excision.

Scleral patch graft →
- Scleromalacia perforans
- Post Pterygium excision.

TA	graft
x useful >2mm perf.	Better str support
Opaque skn.	Stabilizing of globe
Promotes Vascularization → Healing, Bt » Immune rxn. to next	Clear Visual axis

Surgical Tech

Lamellar.
Cov peritomy if req
Trace thru perf
Measure perf
1mm clear area around perf.

full thickness
0.5mm »

Sclera.
Cov peritomy
1mm healthy sclera

devitalized removed
↓
Lamellar dissect"
0.25mm » graft
↓
Sutree Bites ✓

Corneal Keratolimbal graft

Eccentric donor Corneal graft including sup & inf limbal stem cells — transplanted centrally in the host
↓
40% of donor limbus.
It's said it achieves sufficient epithelization in event of limbal stem cell disease in the host.

Ix
- Chemical burn
- Thermal burn
- Aniridia.
- Lattice dystrophy
- Iatrogenic stem cell deficiency
- Corneal Intraepithelial Neoplasia
- CL induced Keratopathy

(*) Youngest possible donor as abundant epithelial cells Limbal stem cells.

Sx Keratome should include 40% circumference of donor limbus
Limbal edge superiorly — so that covered ⊆ sup. lid

Post op Care — Long term steroids + Cyclosporin A ℞

Outcome — good.

Sclerokeratoplasty

Use of CS graft of varying size, shape & position to improve those ℞ resistant disease of cornea that result in dissolution of tissue & production of anatomic or structural defects.

(X) over PK →
- Technically difficult to perform
- ↑ risk of certain complications
- ↑ incidence of graft rejection, 2° glaucoma hypotony
- ↑ allograft rejection & develop^{n} of opaque graft.

CU c involvem^{n} of Sclera.
Total C. melt due to Immunological disorders ℞ Cell Ca.
selected cases of PMD & Ant staphyloma.

Lamello penetrating ↓
4mm dia.
2mm peripheral lamellal rim
full thickness reephrat^{n} 10mm

Lamello lamellar
KP.

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Support ste applied
↓
To ↓ Post op glaucoma

✗ → Complication of PK.
Post op glaucoma
Persistent hypotony

Optical Sector Iridectomy

✓ → last longer PK
Instant relieve (Ambulatory vision)
Demands good donor material
Surgical expertise.

PK disastrous in One Eye pt. that too regrafts.

MOA → Peripheral rays bundle upon central rays to form sharp image

⊙ Lower & Nasal temporal Quadrant.

IX
- CO off centre & encroaches pupillary area.
- Central scar c̄ sufficient clear periphery
- OI in 1 eyed pt & pt c̄ chances of regraft failure >> ↑↑
- 1/2 CO where PK contraindicated.

Pre-Op
- Look for post seg
- Post seg pathologies – OA, M. dystrophies rule out, Nystagmus

Surgical Tech – Small fornix based flap made

Indication specific Corneal grafting techniques.

Cancoindic scar

Causes → Infectious K, Nutritional disorders, Ocular. Trauma & Trachoma

Tissue — Tsephination → Iridodialysis

Complication

- IntraOp Bleeding
- Lenticular Injury

1) Corneal debulking by Lamellar dissection

Explain steps

Ops reconstruction req to ↓ risk of PQs due to floppy iris tissue

2) 1mm Oversized graft — ↓ Incidence of Post PK glaucoma
↓ Hyperopia
↑ ACD

Peripheral Lig Cornea thinning 1-2mm band.
4- & 0/ clock.

•) Conventional Large Diameter PK
Large 9mm Keephine.
✗ → ↑ risk of graft rejection
↑ PO Astig

•) Large Eccentric PK
✓ ✗
↓ Host tissue disparity ↑ graft rejection.
↓ PO Astig

•) Crescentic LK →
Inf Crescentic lamellar dissection
↓
Placement & suturing of matched CS Button.

•) Simultaneous Crescentic LK & Central PK.

½ thickness, Semi Circular donor graft
↓
full thickness PK.

✓
Single donor for both
↓ Ag
blood

Lamellar — Normal thickness
good edge-Edge appos
✗

full — Correct residual A.
Rapid Visual Rehab.

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- Large crescentic resection — remove full thickness crescentic shaped area of Lt corneal thinning
  ↓
  Sutures together.
- Epikeratoplasty
- Tuck In LK 10.5mm keptone — 0.3mm depth superiorly into limbus.
  ↓
  Create lamellar pocket & tuck.
- DALK

TMD

» Superior limbus..
Consist of Opacificat^n & Superficial NV.
↓
Stromal thinning
limbal gutter & progressive ectasia.
causing against the rule astig.

- 2 step Annular Tectonic LK → 180° performed
  ✓ → Controlled Astig.
  → Efficient & of extensive peripheral stromal thinning
- Full thickness Peripheral grafting → difficult
- Limbus based Lamellar Scleral flap covered by fornix based Conj flap.
  ↓
  repair def in TMD.
- Scleral Autotransplantation & Lamellar KP
- Epik
- C/s Horseshoe grafts → greater Curve on Sclera ↓ on Cornea & 8mm teephure
- & & foci Resection →
- Compressive C shaped LK → ↓ severe C. Astig in peripheral C. ectasia.

Keratoglobus

- Epik
- C. Sclerooplasty & maintainence of L →
- Tectonic LK followed by 2° PK →
- Tuck in LK
- Annular CS Ring

Mooren's Ulcer

Step ladder approach

↓

Topical CS

↓

Conj resection &

↓

systemic IS.

Limbal Conj Resection → Resection 2-4mm posteriorly

Cyanoacylate glue → Perf <1.5mm

LK.

PK.

Keratoepitheliioplasty

Other Sx procedure

Limbal Stem Cell Transplantation.

Ocular surface → Tear film
Epithelium of Cornea
Conjunctiva

3 layers of tear film → Stratified, Non keratinized epithelium of Cor

↓

Corneal Epithelium.

Cor surface → Cor fornices — stem cells

Corneal stem cell → Limbus. Move from Basal layers
Centripetal & Circumferential cellular migration from cs limbus.

→ Stem cell.
→ Proliferate into
Corneal epithelial cells

↓ Cor deficiency

Conjunctivitis, Trauma
Sx, Cor Neoplasia,
Chemical burns, SJS,
Epidermolysis bullosa,
Sarcoidosis, Scleroderma

↓ LSC deficiency

Chemical & thermal inj
Aniridia, SJS, epithelial
neoplasia, after multiple Sx,
OCP
Contact Lens induced K.

→ Main sequelae — Conjunctivalization of Cornea.

↓

PED, Stromal ulceration, Scarring

↓

Pain, Loss of vision.

Treatment of Severe Ocular Surface Disease

- Replacing abn. Conj.
  - ↓ Autograft
  - ↓ Conj. trans diff into cornea like epi
  - ↓ ↓ of recurrent pterygia fornix reconstruct.
- LSC transplant
  - ↓ CSC
  - ↓ Basal C. Epi
  - ↓ Supra " "

Classification

- Source
  - Conj.
    - ↓ x
    - ↓
    - Source
      - Self
        - ↓ Autograft
        - ↓ Same/fellow eye
      - Non self.
        - ↓ Allograft
        - Cadaveric ~~CAL~~
        - Living Related donor. ~~L-CAL~~
  - Cornea
  - Limbus
    - ↓ Conj/Cornea

Source
Canics.

Date

Cadaveric. Living related. Auto graft

CCAL. lb CAL

CCALAL lb CLAL. CLAU

Cay. Limbal

If × Cay — Peripheral Cornea — KLAL.

used

Combined (CKLAL) Cay keratolimbal

Limbal tissue harvested 4mm

+

AMT imp

Epithelial Transplantation Procedures

dis → Unilat — Autograft — better prognosis

Bil

↓ Risk of graft rejection

× Need of immunosupp

Conj Autograft → Like Pterygium Sx.

Other Ix — Tumour Excision
- prevents SCM resection
- Conj/Tenon Scarring
- Eliminate problem of Symblepharon formation after chemical injuries. which spread limbus & Cornea.

Conj Limbal Autograft — Chemical inj.
Intraepithelial Neoplasia.
Multiple eye surgeries

Donor — 3 clock hrs at 6. & 12 O clock.
1mm into clear Cornea (200μ depth)
4-5mm bulbar Conj.
Join using Crescent
2 location. 10.30 — 1.30
4.30 — 7.30

↓

Sew the graft & Cover ⊆ AMT.

Postop → A.B, steroid drops
↓ Eye rubbing/trauma
↑ Ocular lubrication.

Complications
localized haze
Pseudopterygium
filamentary keratitis
Micropsy during Sx
Abn Epithelium
Corneal depression

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Ix of CLAL → Bil limbal SC loss
SJS
Aniridia
Cicatricial Pemphigoid
CL induced Keratopathy

Try matching ABO bld & HLA tissue.

Cadaveric Keratolimbal Autograft → >> Bil LSCD.
9 mm keephune — OS lim
Trough avascular — still IS.

Combined Conj & K.L. allograft (C-KLAL) → OCP, SJS
Bil chemical injuries.

- Large diameter lamellar Keratoplasty
- Allogenic Penetrating Limbo-Keratoplasty
- Ex-Vivo Stem Cell Expansion.

LSC Transplantation Ex Vivo

Limbal Stem Cells →

SC do not have 64 kd keratin

SC → daughter cell for diff ⟺ TAC ← divide frequently

Location of LSC → Palisades of Vogt Basal layers

LSC damage →
- Poor Corneal epithelization
- Persistent epithelial defects
- Corneal Vascularization
- Corneal Scaring
- Conjunctivalisation of Cornea
- ↓ VA
- Ocular discomfort
- Unstable Ocular Surface

1°
- Insufficient stromal niche environment

LSC def →
- Aniridia
- Cong. Erythrokeratodermia
- Keratitis ass c Multiple endocrine def
- Neurotrophic Keratopathy
- Chronic limbitis

2°
- chemical
- thermal

SJS.
OCP.
Multiple Sx of Cryotherapies
CL wears
Microbial Keratitis
VKC — chronic limbal Inf

Total / diffuse ~~diffuse~~ Partial / Sectoral

a) Small amt of tissue harvested.
b) No allogenic rejection.

Diagnosis of LSCD →

- Cf.
- Histopath Dx → Impression Cytology stained c PAS shows +nce of goblet cells

Immunostain	Conj	Cornea
CK3	-	+
CK19	+	-

So. In Impression Cyto (CK19 + CK3 -

Stem Cell Markers — delta N P63 α20, 74 ABCG2.

Ix → Slit lamp Exam → features + Look for Palisade of Vogt

Impression Cytology → D shaped mann filter paper.

Ultrasonic Pachymetry → give idea of depth of dissection.

Date
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Post Seg Evaluation →

USM. — Assess L for 2° glaucoma — Chemical Inj

Tear film status.

Adnexal Sts — Dx for eyelid Malposition

Limbal Stem Cell Harvesting

Uni — LSCD — Bil

Uni → live donor

Bil → Cadaver

Autologous limbal epithelial cells	Cadaveric allogenic limbal epi cell	Live related Allogenic Limbal epi cells
2-3mm long dia.	< 40yrs.	
- 1mm post to limbus	Enucleation	
- 1mm into clear cornea	< 6hrs	

LSC Culture Tech → Tissue ← Harvested

↓

Wash ⊆ PO4 buffered saline

↓

Incubated in Dispase II at 37°C for 30 min

↓

Scrape epithelium

↓

Incubate epi in Trypsin - EDTA.

Culture Media — Modified HCE (Human Corneal epithelial cells)

↓

9.7 g/l Modified Eagle Medium (MEM)

+

16.2 g/l Ham F12 Serum.

0.01 mg/l EGF

0.25 mg/l Insulin.

0.1 mg/l Cholera toxin.

Hydrocortisone.

|

Explant Culture System.

↓

Use Amniotic Memb.

↓

Abv & below

3T3 explant Co-culture is modificat^{n}

↓

Stimulate growth

Suspension Culture System.

BM collagen

Dispase

↓

Epi Am stroma

Trypsin

↓

Seperates clumps of epithelial cells into single cells

↓

Transfer to AM

Plastic tissue culture disc

3T3 fibroblasts.

Transplant 10-14 days after limbal biopsy

- AM graft & Cultivated Stem cells
- CL based Tech.

Complications

Post Op
- Microbial keratitis
- Rejection of limbal graft
- Recurrence of NV
- Symblepharon formation.

Intra Op
- Symblepharon release.
- Bleeding
- Corneal perf.

Amniotic Memb Transplant

Date DELTA Pg No.

Uses

Permanent graft

- PED
- Sterile stromal thinning descemetocele & perforation
- SK & Scleritis
- Symptomatic Bullous K
- Band K
- ½ LSCD.

Overlaid graft

- P/Rec Erosion
- Acute chemical / thermal burns
- Acute SJS c/c out TEN
- Chronic recalcitrant K. caused by HZO, HSV, VKC
- High risk. Corneal grafts.
- Excimer laser ablation.
- Plastic Ix as conformer. to prevent lid/lash mechanical insult to Cornea.

clinical

surgical

Corneal Ulcers. — To cover entire Ocular Surf
Foll SPK — " only Corneal Surf
For Bullous K & Band K. — Prokera™
½ LSCD — Implantation of KPro.

Topical — AMX → drops

Prokera — Sutureless Conformer ring fastened with cryopreserved amnion graft.
15-16mm device used

What is AMT → Innermost layer of Placental Membrane

3 layers — 1 epithelial layer
Thick BM.
Avascular Stroma

Natural — has risk of BB infections.

BM → • Promote epithelial cell Migration
• Adhesion & differentiation
Collagen type III & V, IV & VII
L fibronectin & laminin

AM produce Basic fibroblast, hepatocyte & tgf which stimulate epithelization.

↓ expression of HLA ABC DR & β_2 µglb ∴ no immunosuppression Req.

- Anti inflamm
- Anti Microbial
- Anti fibroblastic.
- Anti Angiogenic. (Thrombospondin

Modes of Action

- > Asthetic appearance in stromal defect when compared to tarsorrhaphy
- PEDS → • Avoidance of potential allograft rejection
  - Post op astigmatism of Technic Corneal graft
  - Ease & Convenience of use.
  - feasibility in event of Corneal tissue shortage
  - Preservation of better aesthetic appearance

2) Sterile Corneal Stromal thinning upto 3mm perf.

3) IK & Sclerotis →

4) Symp BK – heals in 3 wk

5) 1/2 LSCD

Total → LSC Transplant

1/2 → AMT — Expansion of Cells
— facilitate re-epithelization of Cornea.

1) Ex Vivo Expansion of epithelial SC
- A natural thick support sub
- Easier transfer of tissue graft frm lab to OT to pt eye
- Unique biol act of AM on surrounding tissue

Amniograft → FDA approved — cryopreserved AM.

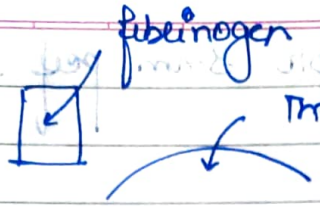
Kills allogenic amniotic cells in Amniograft.
✗ need of immunosuppression
✓ Integrity of Cytokine rich ECM.

foil packages in frozen state.

Stromal side on Recepient bed.

How to know – Touch tip ≤ sponge → stromal side.
stick to sponge.

Suture → sutureless
- Shorter Ex time
- Feasible under topical Anes
- Ease of Post op / Care.
- Lack of suture related complications.



glue tech

On PBK → Create lamellar pocket so that epithelium goes above.

Cryopreserved AMT

↓

Check

↓

neg for ← HIV, Hep B, C, Syphilis

↓

Separate placenta under laminar air flow

↓

Soaking sol → Penicillin 50 IU/ml
Streptomycin 50 µg/ml.
Gentamicin 200 µg/ml.
Amphotericin 2.5 µg/ml

↓

Wash

↓

In sterile tray ⊆ stromal side up.

↓

Autoclaved millipore paper discs 0.45µ put on exposed stroma

↓

Cut into pieces

0.5 DMSO in 0.01M PO_4 Buffered Saline

↓

sent for Bact & fungal culture

filter paper wrapped Memb transferred to sterile bottle containing Dulbecco's modified Eagle's medium + glycerol (antiviral & Antibact)

Stored at -70°C in deep freezer.

Alternative to Keratoplasty

- Chronic symptomatic BK
- Neurotrophic ulcer
- Mooren's Ulcer
- Impending Corneal perforation
- Selected cases of Acute IK not amenable to medical Rx

In Chronic & Bullous K

In lay	Overlay Tech
- Scaffold for epi cells - Migration of host epi cells on Memb	- As patch — CL. - epithelial healing underneath layer of AM
	AMT. Prokera.

↓

May get entrapped

∴ Limit C. transparency

For Neurotrophic Ulcers

Multiple layer → promote epithelization
→ Prevent surf exposure, dryness & fxn like tarsorrhaphy

for Mooren's Ulcer

Complications → Hematoma formation
Retraction of Memb.
Granuloma formation
Premature degradation
Suture related.
Microbial Inf.

Tx, Corn surf reconstruct" → Chemical & thermal inj
Pterygium Sx
Cicatrizing Conj
Conj Tx of GSSN

Corneal surf. Recon → • PED • Shield Ulcer • SJS
• PSK • Ulcerative K

Glaucoma Sx → ↓ scarring
for repair of leaking blebs
Tube valve Implants

Lid & Orbital Sx → SJS
NED — punctal patch
Conj Orbital prosthesis
UL reconstruct"
fornix formation in cryptophthalmos

Phototherapeutic Keratectomy

Ablate Sup Cornea to remove superficial corneal Opacities

193 nm UV rays ——→ Photoablative decomposition.

Ix

- Reis Bucklers Dystrophy
- Salzmann's Nodular Deg
- granular D.
- Spheroidal D
- BSK.
- C. opacity after pterygium excision involving visual axis

Aim

TVA.

Delays lamellar & PK.

guidelines for Pt selection → Depth of Opacity < 100μ
Retain 300μ of C. Stroma
Sup, homogenous opacities easier to Rx
Realistic expectation.

Methods →

Detailed H/O
BCVA
Detailed slit lamp Biomicroscopy.
Post Seg
USG
Keratometry
9 pt pachymetry
Refraction

Date
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Surgical Tech

a) Removal of C. epithelium : — Manually ⊆ hockey stick spatula.
- else use 20% alcohol
- Excimer laser.

b) Ablation of superficial Corneal Tissue
abl. dia = 6mm.
Amt = 60-100μ
>100μ — subepithelial haze
- Abl using coupling fluid
- Eye tracking ✓
- Put BCL

Complications → Hyperopic shift — Shallow abl use of Masking agent
Corneal haze
Glare
Myopic shift
Infection.
Recurrence after Original pathology

In Corneal Ulcers

Excimer — Tissue sterilizat^n by abl
eliminate Org
Surrounding Necrotic tissue
debulking effect
Improve drug peneteat^n.

» Sup. Keratomycosis
Metaherpetic Ulcer

Corneal Tatooing

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CuSO4 1st

Basic Principle – Impregnation of material in C. stroma.
to imitate iris & pupil
↳ improve cosmesis
↳ Optical ⇒ by converting nebula (× scattering of light)

– ∴ glare & Monocular diplopia due to traumatic iris defects & aniridia

Ix
- C. Opacity & mature white cataracts — ⊆ ↑ chances of phthisis
- Iris defects
- Old firm flat scars in Quet blind eyes

Avoided
Anterior Staphyloma
Phthisis bulbi
Glaucoma
Adherent leucoma
} Risk of Endocyclitis

Methods
↓
- Chemical reduction.
- Direct inoculation methods.

Chemical Reduction →

✓

Easy. Quick.
↓ precise

✗

fading of colour »
Iridocyclitis » chance

a) Anaesthesia
Gm debride
Mark ⊆ neg. keephine. Size

a) 2% gold Cl ↖ Neutralize ⊆ Sodo Bi Carb
↓
Applicator 3-7 min.

Beacon

2 min

Black

b) 2% Tannic Acid. ↘ AgCl
or
Epinephine
1:1000
↓
Atropine
↓
Eyepatch.

b) Palladium Oxide. reduced by Vit C.
c) 5% fresh $FeSO_4$ + 5% tannic acid — Black
d) H_2O sol Ag salts + Hydrazine hydrate — Brown
e) Lamp black + Cobalt tannate — Blue
f) Burnt Sienna — green

Direct Inoculation

✓ Permanent results ⊙

↑ Difficult

⊙ as dyes tend to be phagocytosed by keratocytes ∴
× leaching of dyes

- Lamellar pocket → Femto assisted may be
- Multiple Needle puncture at 1 plane

Glue application

Ix
- To prevent Epithelial ingrowth in LASIK pt
- Repair of impending perforation < 3mm
- Closure of leaking filtering blebs
- Occlusion of lacrimal puncta
- Skin closure in oculoplastics
- fixing of Rigid CL in severe Ocular dis (Chemical burns)
  - AMT
  - Pterygium
  - FTMH (Sx)
  - Sutureless SALK
  - Tempory KPro.

Types

- Biological
  - fibrin glue
    - Tisseel ✓ Behring
    - Coseal ✗
- Synthetic
  - Cyanoacylate
    - Butyl monomers

Cyanoacylate glue → Butyl monomers — Rx of corneal perf upto 3mm in dia.

Polymerize due to active double bond ⊆ O_2.

Histo-toxicity ∝ Length of Alkyl side chains
Vasculauty of tissue applied.

∝ 1/chain i.e » short chain & ↑ vasc tissue

∴ longer alkyl chains — N-butyl-2-Cyanoacylate

Polymerization — occur thru contact ⊆ H_2O & weak base

Hydroxylation — Exclusion of O_2 frm subs being bonded

Fibrin glue — highly conc fibrinogen apeotonin sol (factor XIII)

+

Sol of thrombin + $CaCl_2$.

Bio effects — direct applicat^n to bed + BCL

↓

C.S. melting

) Release of Collagendytic Enz
) x. Re epithelisation into zone of damaged steama.
∴ x PMN → x. Enz
) Anti bacterial properties — B. Static against gram +ve

↓

Method of application → Tuberculin syringe
Applicators
Aerosol application.

Direct application
Overlapped
Using a Suture.
Visced elastics.
Corneal Patch

↓

BCL

Post op

look for

Epithelizatn — Vasculonzatn — Corneal thickness.

Adverse effects
- Scarring of Corn
- GPC
- Polymerizatn of C. endothelium & Iridolenticular adhesions
- Close monitoring for inf × 6wk.

Rare — Retinal toxicity
Cataract
Granulomatous Keratitis

Fibrel (5)
- → $CaCl_2$
- → Aprotonin
- → Thrombin
  - 4 → Slow solidificatn
  - 500 → Fast

Sealer
Protein Concentrate
↓
Clottable protein
Fibrinogen
Plasma fibronectin
Factor 13
Plasminogen

VA → Stenopic slit

T & E chart — Meridional orientation

Corneal Manifest Refraction

Outward

Myopia x 1.2

Hypex x 0.8

glasses

Inward

Myopic x 0.8

Hypex x 1.2

Keratometer → Pulsating mires

Very ↑ → Minification of mires

KeratoConus

Corneal Ectatic disorders → Chronic Biomechanical failure that leads to thinning, protusion without any Inflammatory rxn.

- Astigmatism
- HOA
- Ass c Myopia

3 Thinning patterns

- KC
- PMD
- KCg.

KeratoConus → Cone shaped protusion of Cornea
Bil but Asymmetric

Ass → Downs, RP, LCA, MVP, ED, Marfan's.

Ocular → Atopic Dermatitis, VKC

Other reason of Ectasia → Trauma
Surgical procedures
Post Refractive Sx — RK
LASIK
PRK.

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Clinical findings → • Progressive visual blur & distortion
↳ Myopia, Astig
• frequent change of glasses
• Photophobia, glare, Monocular diplopia
• Symptoms related to Ocular allergy.
• Eye rubbing — (C. BioMech stress)

Exam

VA
BCVA — & approaches
BCVA ≤ pinhole — Visual prognosis

~~Scissors~~ Scissoring reflex
Corneal, paracentral thinning of stroma
↳ Inf, InfT
PCN (stress on CN out stretching)
Rizzutti sign
Fleischer Ring
Vogt Striae.
Munson sign.
Haziness of 2nd Purkinje image at 2nd post surface of cornea when illumination performed in an oblique, lat way — Presence of stromal lamellae irregularities ≤ subsequent changes in corneal optics
Hydrops — Ruptures in DM. ↷ C. Edema
Scarring

Vogt striae → Vertical lamellar folds observed in post stroma & can be seen as fine and roughly // striations or stress line.
» Oriented according to protrusion axis.
- disappear when gentle digital pressure applied to Ocular globe

Corneal Topography — Placido - based.
KISA Index.

1. **Tomography** — Horizontal slit Scan
Rotational Scheimpflug
↑ freq USG.
OCT.

a) Elevation Map → • BFS (8mm zone) — since this zone is available for majority of examined eyes
• BFTE.

b) Pachymetric — the stability of Cornea
gradual thickening ratio centre → periphery
steeper ↑ in thinned area to periphery

c) BAD — Belin Ambrosio Enhanced Ectasia display.
D value - based on Regression analysis that weights differently each parameter.
>1.6SD — yellow — Suspicious
>2.6D — Red — Abnormal

FFKC

Contralat eyes ⊆ Normal topo 4m asymmetric KC.

✓ Ectatic Susceptibility

Normal Topography CCT

FFKC.

- Holladay → Hot spot on tangential Map > Sensitive
  ↓
  lowest pt on Pachy map.
- Post elevation map. >15μ.

If using BFTE RS — Back values >>

Hot Spot

- Ant Tangential Curvature Map
- Relative Pachymetry
- BFTE → Post elevation map

↓

Same pt

KCS

Topographic dx.

↓

Abn steepening > I

I-S value → vertical gradient in 6mm region

N	<1.4D.
KCS	1.4 - 1.9D
KC	>1.9D.

Oblique Cylinder >1.5D.

Steep K >47.D.

Wavefront Analysis → HOA ↑ in KC pt

» Vertical Coma — Sp – 71.9%
Ss – 89.3%

∴ Modified Amsler Krumeich classification by Alio & Shabayek

Also improve CDVA in advanced KC.

Segmental Tomography & Corneal Epithelial Mapping →
Normal Inf > Sup, Nas > Temp
Tries to smoothen the irregs.
Over the Cone Epi — thin
Around — Thickens
] in doughnut pattern

• Thinnest pt of Epi ⇔ Max pt of protrusion on elevation maps

∴ Can detect mild KC
Monitor the progression.

Corneal Biomech

- NCT — Ocular Response Analyser
- Scheimflug Camera based — Corvis ST
- Brillouin microscope — Weakening shift

ORA — CH Corneal hysteresis
CRF Corneal resistance factor.

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Confocal uscopy: ↓ Ant & Post stromal keratocyte densities ↓ & stromal Nerve diameter —

↓

keratocytes 4* IL-1 recep. ⟶ ↑ no. of keratocytes.

Specular uscope: ↑ pleiomorphism rate & ↑ :: of small endothelial cells

Patterns & classification in Ectatic Corneal Disorders

Morphologic patterns

Seen on Tangential / Curvatural Maps.

Cone.

- Nipple.
  - < 5mm
  - Steep.
  - Cone apex - C, IC, IT.
  - CL fitting easy
- Oval
  - 5-6mm
  - ellipsoid
  - IT.
  - difficult
- Globus
  - > 6mm.
  - 75% Cornea
  - >> difficult

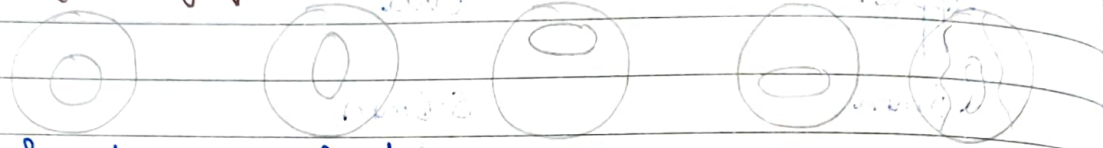
Tomographic patterns

- Curvature based
  - (N) → flat - Centre → periphery
    - Nasal > Temporal.
  - Enantiomorphism
  - patterns
    - Round
    - Oval
    - 2B
    - AB
  - Saggital Curvature
    - Irregular
- Elevation Based.

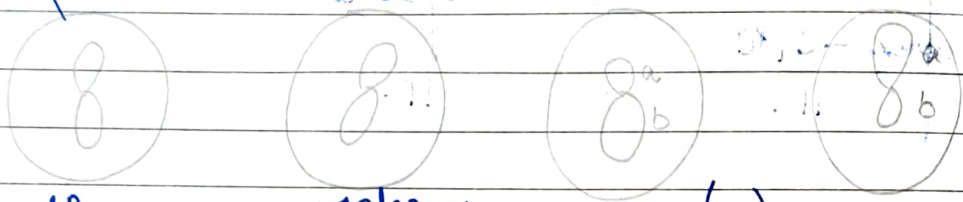
Regular

SB. ≤ rule against Orthogonal

Irregularity pattern

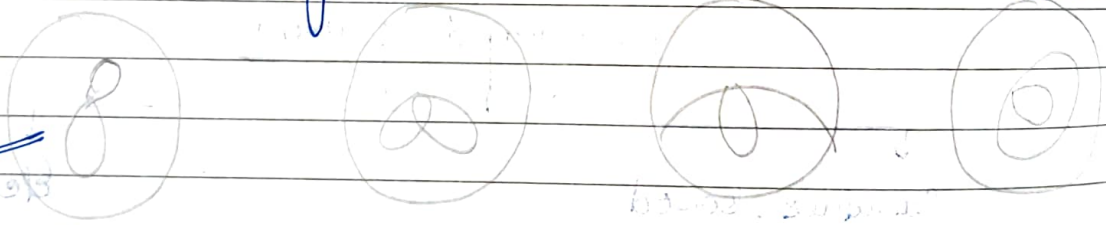


Round Oval SS IS Irregular

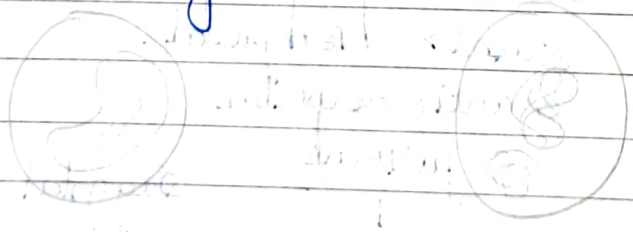


SB SB|SRAX Non Orthogonal hazy 8. AB(IS) > 1.4D AB|SS > 2.5D on 3mm Central cycle

Phenotypic of FFKC



AB(SRAX) >22° angulatn Butterfly Crab claw Vertical D



Clown. Vortex.

Elevation based DELTA Pg No.

steep = -ve flat = +ve.

Reference surface by Berlin

- BFS → Qualify shape
- BFE
- BFTE → Quantify values

(N) → Aspheric ellipse or Toric ellipsoid

Ideal dia of RS — 8mm
" Mode. — float mode.

Abnormal Cornea

BFS float Mode
- Skewed hourglass
- Tongue like Extension
- Irregular patterns.
- Isolated islands

BFTE float Mode.
In 8mm Circle
A — >12μ
P — 15μ.
] Abn.

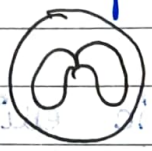
Locate Cone

Date
DELTA Pg No.

Locate Cone on BFS float mode — ∝ INTACS

Central	< 3mm
Paracentral	3-5
Peripheral	> 5mm

If Cone is peripheral
↳ On elevation map — . Kissing bird appearance

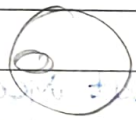


Pachymetry Based

(N) → Cone shape.

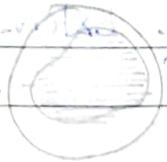
TL — Thinnest location

- Horizontal displacement of TL
- Dome shape
- Bell Shape — PMD
- Globus









KC

Date 156
DELTA Pg No.

Def chronic, bil, deg, non inflammatory thinning of cornea characterized by progressive steepening, thinning & apical scarring

× Unil KC — but unilateral presentation ④
Asymmetric.

Classification

⊙ Based on type of cone

⊙ KISA Index. K > 47·2D
in 3mm radius U & L > 1·4D

⊙ Rabinowitz Criteria
Central Corneal power 47·2D
Inf-Sup (I-S Value) Asymm >1·2D.
SimK >1·5D
SRAX >21

⊙ Amsler Krumeich Classification.

Severity	K(D)	Thickness μ	Spherical Equi (D)	Cornea
4	>55	<200	Not measurable	✓✓
3	53-55	300-400	>-8	×
2	<53	401-500	-5 -8	×
1	<48	>500	<-5	× Central scar

Ecc steepening

Alio Shabayek Modification + HOA

Amsler	+ RMS of Coma like aberration (μ)
4	>4.5
3	>3.5-4.5
2	>2.5 - 3.5
1	1.5-2.5

Belin et al ∝ Progression & symptoms

- Symptomatic → ↓VA due to Irregular A.
  - Progressive
  - Non Progressive
- Asymptomatic (ectatic changes on post- defined by Reg)
  - P.
  - NP.

Progression →
- Progressive steepening of Ant C
- Post C.
- Progressive thinning 4m periphery to TP

Rabinowitz et al

Stage	CDVA	KSV	KI	Other indices	Rmin (mm)	Retinoscopic signs	Cornea slit lamp exam.	D.D.
Level 0	20/20 - 20/15	<30	1.004 - 1.007	All four indices N	7.8 - 6.7	Hunt	Clear	Horizontal Oval found (DC)
Level 1	20/25 - 20/15	30-55	1.07 - 1.15	some Abn	7.5 - 6.5	Distorted RR. Sassoo	Clear RR +	Cone base ✓
Level 2	20/60 - 20/20	55-90	1.10 - 1.25	1 - Abn	6.9 - 5.3	Clear Sassoo. difficult	Clear Apex Horner & decentered RR, VS	
Level 3	<20/125 to 20/30	90-150	1.15 - 1.45	1 - Abn	6.6 - 4.8	Distinct S Impossible	Cloudy apex RR, VS, Munson.	
Level 4	<20/400 to 20/100	>150	>1.50	"	<5.	"	Scar & Opaque apex Munson sign.	

KSV - Index of Surface Variance - CS irreg
CKI - Central KC Index - severity of central KC
IHA - Index of Height asymmetry w/ IVA based on C. elevation
IVA - Index of Vertical Asymm - Curvature Asym.
KI - K Index " " "
IHD - Index of Height Decentration - describes decentration in elevation data in vertical direction

Staging

ABCD classification

	A (3mm zone)	RRC B	Thinnest C	BCVA D
Stage 0	< 46.5 D	< 57.25 D	> 490 μ	> 20/20
Stage I	< 48 D	< 59.25 D	> 450 μ	< 20/20
Stage II	< 53 D	< 65.5 D	> 400 μ	< 20/40
Stage III	< 55 D	< 68.5 D	> 300 μ	< 20/100
Stage IV	> 55 D	> 68.5 D	< 300 μ	< 20/400

Condition of slight ectasia & Asymm astig which was non progressive, » pt of unil KC or Lr family of those c KC.

KC
- Other (No clinical Topo. changes)
  - ↓
  - FF
- ✕KC Topographic changes
  - ↓
  - KCS

Labirowitz — subj classification.

	Normal	KCS / Subclinical FFKS	FFKS.	Early KC.
Slit lamp.	–	–	Steamal thinning VS; FR, Munson Sign, Conical protrusion	–
Retinoscopy.	–	–	+	+
↓ SRAX → 30° → KC in 8yrs	–	+	+/–	+
		Unil KC eyes	✕KC eyes.	Recently: Subclinical KC. ↓ Post elevatn.

	Inf Keratoconus / Pellucid like KC (PLK)	PMD
Nature.	Central / Paracentral	Peripheral Ectasia.
Age of presentatn.	Early teens.	20-40.
Slit lamp.	Central / Paracentral	Inferior peripheral thinning
~~Curvature Map~~.	Crab claw.	Crab claw.
Elevatn Map Cone	Central / Paracentral.	C/PC/ Inferior
Curvature Map Kissing bird	✓ (±)	✓ in early & Mod
Thickness Map.		
Bell Sign.	×	✓
Thinnest location	May be displaced	Usually largely displaced.

Clinical parameter	KC.	PMD	KG
Etiology	× Known	× Known	× Known
Onset	Puberty	2-5 decade.	At birth
Location of thinning	Central Paracentral	1-2 mm arcuate band of thinning in Inferior cornea.	Generalized
Location of Protrusion	Apical, same as thinning.	Superior to thinning	Gen of globulai
Scarring	✓	×	×
C/f.	↓ vision from Myopia Astigmatism. Acute Hydrops ✓	→ Rarely	Rupture with mild trauma. Rarely
Sign.	Conical ectasia, Vs, Ms, Rs, FK, Oil droplet sign, Scarring	Bird belly side profile Steady 1 arcuate band	globular ectasia
Pachymetry Map	Dome shape	Bell sign.	Gen thinning

Date 15/9
DELTA Pg No.

Pellucid Marginal Deg

Rare, bil, asymmetric, non Inflam ectatic disorder of Cornea most commonly associated with an arcuate, narrow band of thinning in Inferior peripheral cornea @ 1mm from limbus.

PMD — Beer belly
progresses over time
Thinning 4-8 O clock.
>0→

Classification

Early — Moderate — Advanced.

Tomographic features

a) On Curvature Map — crab claw appearance

Pellucid like Keratoconus (Inf. Cone of KC) — PMD

- Inf Corneal thinning +

b) Elevation Map - ± BFS float — Location of Cone
- Kissing bird sign
Not hall mark.
PLK — PMD.

c) Corneal thickness (pachymetry Map) →

Bell shape / Bell sign — hallmark of PMD
amt of displacement on Y co-ordinate
should be longer in PMD esp in Adv cases.
↓
May be missed in advanced PMD.

Keratoglobus

Bil. non inflammatory corneal thinning disorder characterized by generalized thinning & globular protrusion of cornea.

» Congenital.

DD KC, PMD, MegaCornea, Congenital glaucoma
CDia.

Cf Present at birth
↓vision Myopia & Irreg Astig.
Acute hydrops +/-
globular protrusion of cornea ⊆ diffuse thinning
» ~~Localized~~ limbus
360°
Inferior paralimbal thinning PMD —.
whole cornea protrude here
VS, AR ⊖
Do check CD

CXL (Corneal Collagen Cross linking)

Collagen → stiffens
Lysyl oxidase.

Cross Linkers

- Sugar → AGE → ↑ time. → ✓ ↓KC in diabetics.
- Aldehydes → Heat valves → formaldehyde releasing subs → Genepin
- Radiation → UV
  - Blue light headers polymers → UV difficult / x effect in transparent Cornea
  - ∴ photosensitizers
    - Rose Bengal + green light
    - Genepin.
    - Acridine Orange. → Toxic.
    - (Riboflavin Vit B2) Non Toxic

What instead of UV/Crosslink
- formaldehyde
- Glutaraldehyde
- β ribo alcohol
- Genepin

] Toxic

Abs Spectrum 365-370 nm
Conc = 0.1%
Time = 45 min

Two lamps
- Hg
- Quartz → 2 mW/cm²

Double diode - 2LED 3 mW/cm² (R) — Std

> 400 µ Cornea

✓ Stop progression
✗ VA improve ⁿ

Effects of CXL

↑ resistance against Enz digestion
Reduced Biodegrat ⁿ
Demarcation line. ✓ BioMech stiffening ⊙
↓ Corneal Swelling
↑ shrinking temp
↑ Collagen fibre diameter

Other applications of CXL

Rx of ulcers (PACK) Photoactivat ⁿ of Chromo phores
CXL of AM, Sclera, Lens Capsule.
Collagen matrices for tissue Eng.
Standalone tool for Refractive Correct ⁿ

Other Mode

epiOn
Iontophoresis
Thinned Cornea
✓ VA improve
↓
INTACKS
TG - PRK
↓
Hypo-Osmolar Riboflavin
↓
To swell Cornea

⊙ To study Biomech changes — USG, Supersonic shear waves, OCT, Brillouin uscopy

Key Ingredients in CXL

Dose of UV
Conc of Riboflavin
O_2.

Jew Sir in CXL (Mech)

Riboflavin — hydrophilic molecule.

↓ of neonatal Jaundice.

singlet O_2

Superoxide Anion.

Type I

↓

Aerobic Condition ($\subseteq O_2$)

10-15 s

↓

depletion of O_2

Type II

Riboflavin → CL

UV

O_2 → O^-

H_2O_2 → CL.

depletion of O_2

Reduced Riboflavin

e⁻ gained

X abs UV.

∴ O_2 required.

↓

To maintain Type I & Type II rxn.

Riboflavin diffusion · Dresden protocol

Time dependent

∴ standardisation of dropping tech.

Riboflavin delivery Tech

Poor diff thro epi ∴ Epi off Tech in Dresden

Epi-On

Trans epithelial

Iontophoresis

femtolaser

Accelerated CXL.

BAC 0.01%.

Dose → ↓ Soak time
want Epi On ⟶ ao epi off pain.

Procedure
Energy dose = 5-6 J/cm²
Intensity = 3mW/cm²
Time = < 30 min. Total time = 1hr

- sufficient nbo
- ↓ IOP → adequate rxn time
- Enough time for O_2 to diffuse

∴ CXL Rx is time dependent if energy dose is constant
because O_2 availability

Relevance of O_2

To study effects of CXL

By Biomechanical characterization of Cornea.

- Rtp extensiometry
- Advanced Extensiometry
- Brillouin Microscopy
- Air puff deformation.

If x Riboflavin then Rose Bengal + green light
↓
0.1% deepithelized

Biomech effects of CXL → CH (Corneal Hysteresis)
CRF (C. Resistance factor)

ORA provides » Info.

& for Thin Cornea →

- Epi-On CXL → ↓ duration of Ribo soaking
- Pachymetry guided epi debridement → ↑ Ribo. Conc
- use of hypoosmolar prep → CXL ⊆ Soft CL in situ.
- ↓ UVA dose

Riboflavin — also acts as shield for underlying ocular tissue such as Endothelium
Iris
Crystalline lens.

0.1% Ribo + 20% dextran → can thin out Cornea to the point where endothelial damage may be a possibility → Evaporation
→ Colloidal Osmotic effect of dextran pulling out stromal tissue.

Epi on / Epi off → 40μ diff.

Mx of Keratoconus

Date
DELTA Pg No.

Aim
- Halt progression
- Reducing corneal surface irregularity
- ↓ residual Ref error

CXL plus

Spectacle & CL — PRK — TE & PTK — Intacs — PIOL

CXL Rx parameters → Age young KC; old PMD. > Complications
>35 yrs

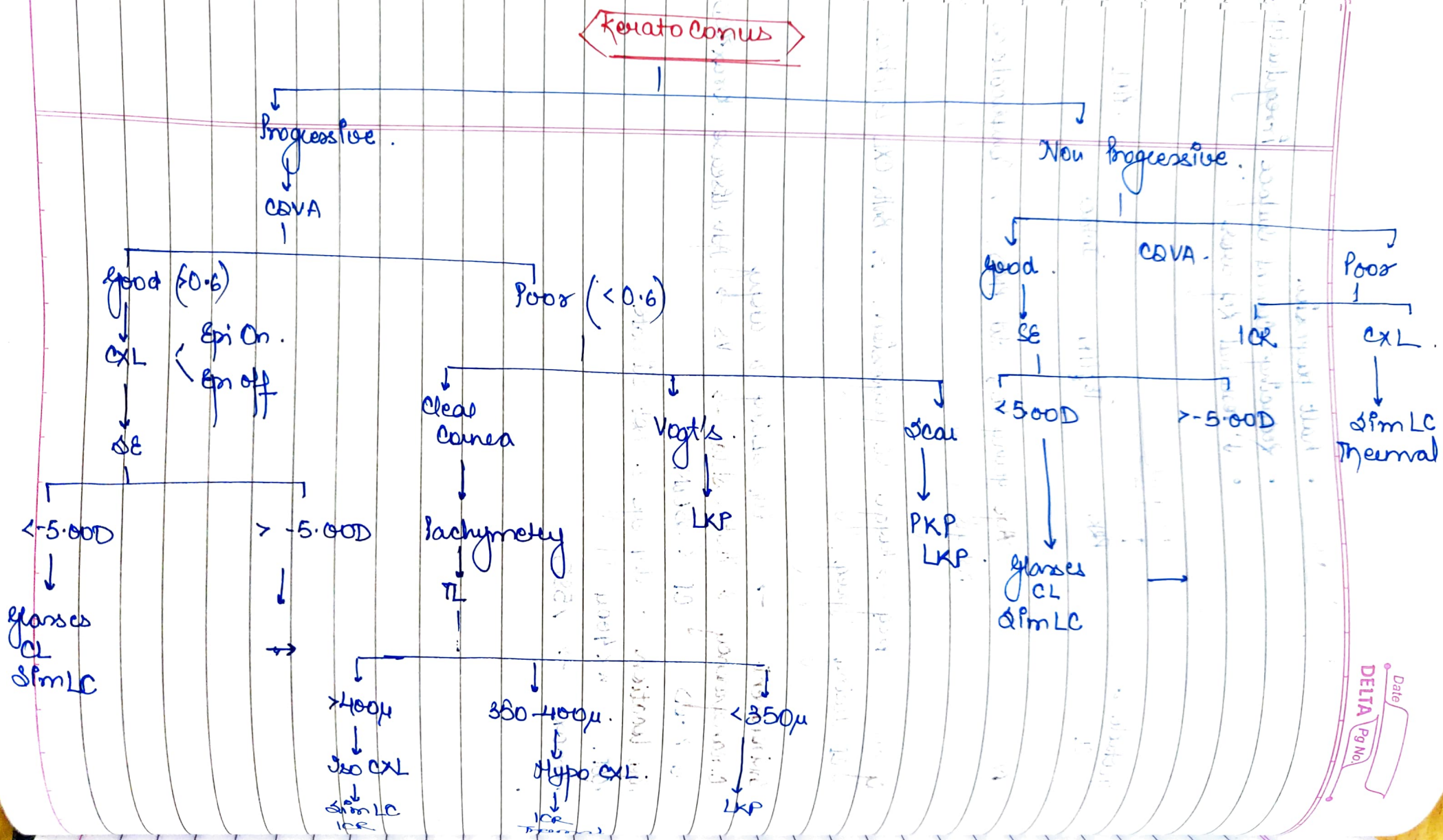
Gender Beg → trigger KC progression. ∴ Both CXL & Intacs CI during preg.

Environment → Eye rubbing & atopy

C. transparency & Vogt striae → VS → Adv disease. Kmax >60D

S.E > -6D CT < 350µM.

- Geo location — dry eye & hot climate.
- COT. : x < 400µ
- Kmax → >58D


Keratoconus
Progressive.
CDVA
Good (>0.6)
Poor (<0.6)
CXL
Epi On.
Epi off
SE
<-5.00D
> -5.00D
Glasses
CL
DLM LC
Clear Cornea
Pachymetry
TL
>400μ
Epi CXL
DLM LC
ICR
350-400μ.
Hypo CXL.
ICR
<350μ
LKP
Vogt's.
LKP
Scar
PKP
LKP
Non Progressive.
CDVA.
Good.
SE
<5.00D
Glasses
CL
DLM LC
>-5.00D
ICR
Poor
CXL
DLM LC
Neural
Date
DELTA
Pg No.

Date DELTA Pg No.

Transepithelial or Epi On CXL

* removing C. Epi → Post op Pain
  Long recovery time
  " to resume CL
  Corneal haze, melt
  Infection
  Endothelial decompensation.

Riboflavin — Isotonic 0.1% → 40min
" for Epi On 0.5% — 15×20min

↑ Penetration through intact epi

- Topical Anaesthetics
- Iontophoresis
- BAC-EDTA → single C interface & CXL action.

Iontophoresis → Electeo pulsion & electeo-osmosis
Riboflavin — neg charged — shortening of imbibition time while preserving epithelial integrity.

↓ tissue damaging & stromal remodelling as shown by
- CD34 — marker of normal keratocyte proliferation
- TUNEL (TdT mediated dUTP-biotin nick end labelling) — Marker of Apoptosis
- MMP-1 — (Tissue remodelling process)
- Collagen type I

0.1% hydrophilic — Unable to cross barrier (Epi)
Need debreah free nbo used.
180µ — Demarcation line.

↑ penetration → EDTA, gentamicin, tetracaine

↑ permeability riboflavin → Ricolin TE

0.1% riboflavin 5' PO_4^{3-}
15% Dextran
Na Edetate
Trometamol
NaCl

Various Riboflavin formulations

	R5P	Extra	Dextran
Sooden	0.1%		20%
Ricolin TE	0.1%	Na EDTA Trometamol NaCl	15%
Mediocross TE	0.25%	NaCl BAK	HPMC
Paracel	0.25%	Na EDTA Trometamol NaCl + BAK	HPMC
Ricolin +	0.1%	Na Edetate Trometamol Various NaP Combinations	

Accelated CXL

Date
DELTA Pg No.

Bunsen Roscoe law → of reciprocity of photochemistry states that the photochemical effect of UV light is a amt of energy delivered & should be equivalent for equivalent total doses regardless of relative irradiation time & intensity for each protocol.

		Energy	Time	Total Energy dose
Std	—	3mW/cm²	30 min	5.4J/cm².
	70% ↑ C. rigidity			
Rapid	—	10 mW/cm²	9 min	
		9	10 min	
		18	5 min	

? to be seen → Corneal stromal demarcation line at 300μ — surrogate of efficient biomech effect. suggest keratocyte perturbation

In some study ACXL has ↓ prominent.

↓ disruption of subbasal Nerve plexuses ∴ rapid recovery.

Role of O_2 Imp for Biomechanical part of CXL. process to occur. There is critical point.

Date
DELTA Pg No.

Cretan protocol → PTK + CXL

Excimer LASER & Refractive Sx Combined with CXL.

Athen's Protocol → ~~Higher fluence~~ ~~Use of dextran free Riboflavin sol~~

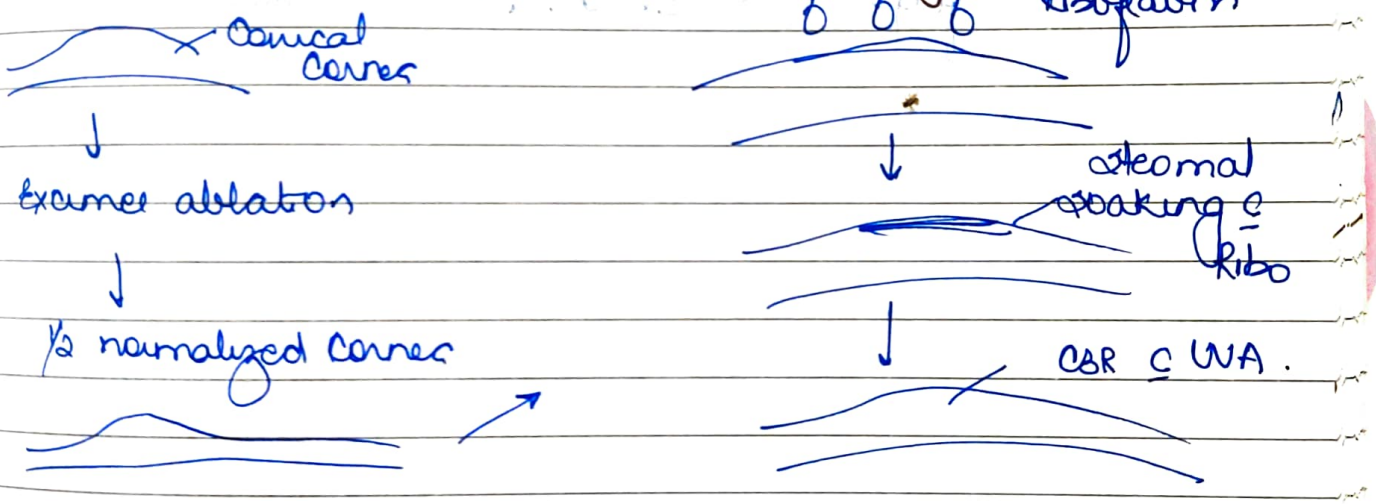
↓

CXL + Topoguided excimer normalization of ectatic Cornea

Use of C3R

- Post LASIK ectasia
- Px CXL in routine LASIK
- In situ femto assisted C. Ectasia
- C. deturgescence in PTK
- Px in adjuvant to ~~Bowman~~ Kpro.

Athen's Protocol drug



Indices for Evaluation →

IHD — Index of height Decentration

ISV — Index of Surface Variance

↓ IHD — Cone less steep

↓ ISV — >> regular but Corneal Surface.

CXL procedure → prompting Corneal surf flattening & thickening.

✱ Do look for ISV, IHD value after C3R.

LASIK - CXL

- flap limited to 110μ as compared to 130μ
- disinfection also.

Remember these are :-

Normal Cornea

½ energy

Keep in mind — don't overcorrect Astigmatism else Comma affect

- Small Optical Zone 5.5 mm.

flap ↑ Excimer ↑ CXL.

Date
DELTA Pg No.

LASER PTK to remove Epi

Dresden Tech

8-10mm epi removed

↓

0.1% Ribo + 20% dextran T-500 x30min

↓

370nm UVA x 30min of 3mW/cm²

Epi On Tech — Proprietary Ribo formulations & Anaesthetic drops mush up Epi

20% effective

	Std Epi off	Epi On
↓max	2.4D	1.1D
↑steengh	70%	20%

INTACS with C3R

Put Ribo paracentrally → Min. Epi surf disturbance + ↑ fluence UVA

⇓

- faster re-epithelization, Visual rehab
- faster diffusion
- Selective CXL of Ant 2/3 Cornea

↓

⇓ → • ↓ inadvertent tearing that enlarged side cut
• Larger Biomechanical change in compromised cornea.

Intacs works as spacer elements between bundles of corneal lamellae producing arc shortening effect mainly

post part of cornea weaker than ant part.

Thermal procedures ≤ CXL

Keraflex. CK+

Keraflex → Made use of Central ring that placed an annulus of 4mm diameter over the cornea & pupil & introduced a thermal shrinkage effect.

CK+ C. shape & vision are improved without removing any. C. tissue.

Lasik cause Ectasia
PRK thinning
PIOL x > 45
Intacs — x Correct Spherical error.
RLE for Myopic ~~difficult~~ IOL Calculation

IOL misalign by 30° → 3.3% undercorrection

PIOL — Phakic IOL → ICL → Superiority in post op visual performance but also for safety & effectiveness in correction of moderate to High Myopic Astigmatism.

Toric

PXL → Photorefractive Intrastromal Cross Linking

In → • Healthy Cornea of pt c/ ↓ RE.
• ↓ level of ectasia in combination c/ customized refractive intervention.

It is customized application of CXL → acting by reshaping cornea by means of localized differential tissue steengthening.

Epi On Epi Off

Epi On (X) → UVA → Ys absorbed Riboflavin — Inhomogenous transepithelial diffusion.

⇓

↑ fluence UVA via KXL II device upto 45mW/cm² Riboflavin application — 1st step — application of Paracel

hypotonic 0.25% rtbo + 0.02% BAK
*4 min
Open epithelial fxn
> 4min — Epi sloughing

⇓ (+)

Vibe X Xtra 0.25% Ribo isotonic solution
* 6min a drop every 30s

Date
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Ortho K + CXL → slowing axial elongation.

RGP CL worn at Night during sleep

↓

Can arrest progression of Myopia.

Ortho K. → Decorin CXL agent (galacorin)

(Temp) (Permanent)

galacorin — challenge is how to deliver.

Penetration Enhancer + applicator cup.

Definition of Progression

Date DELTA Pg No

a) ↑ 1D in Kmax ∞ of Manifest Cylinder 1yr
↓ CDVA in 1yr
CL require replacement every 2yrs
] Dresden Indication

b) ↑ 0.50D SE & ↓ CCT > 5% — Vinciguerra
K ↑ > 1.5D in 6mth

c) ~~Dresden Tx~~ → Myopia / Astig ↑ 3D at >

d) Hersh → Kmax ↑ by > 1D
SE > 0.50D

d) Zotta et al: MRSE > 0.75D. ΔKmax > 0.75D in 6mth

e) Chatterjee & Tafazzi — ΔKmax > 1D — in 12mth

f) Shetty et al — Δ Kmax > 1-1.5D. ↓ CCT > 5%] 6mth
≤ corresp change in refraction

Repeat CCT in follow up → Adults > 3mth
Children — > 6mth.

Do IntraOp OCT after putting abo deeps — as it tells if Haziness has occur even with hypotonic solution.

Epi off » deeper & homogenous keratocytes apoptosis & late demarcation line at 340µ

Penetration → Epi off » Pulsed » Epi On.

High risk pt → <20yr old — eye rubber, corneal scar
Unilateral KC — 2nd eye
CDVA 6/12
Advanced KC where Visual a scleral lens steroid user → hormonal changes.
young ♀ expected to have multiple preg.

C/I to CXL → Hst to riboflavin solution
CCT < 300μ
H/O corneal Dx or pathology
HSK.
Preg/Lactation.

↓ need of CXL → Smoking, DM ⟹ Natural way of CXL

Ix for epi On CXL → Mentally challenged.
Thin Cornea ≤ ↓ Endothelial Counts
Advanced Ocular surface disease pt

Complications of C3R → Epi off → CL use.
Topical steroid & UA exposure → ↓ host defences
↑ risk of Keratitis

- IK
- Non healing epithelial defects
- Sterile infiltrates
- Gaping of C. Incision In cases of radial/tangential I

Rare endothelial damage → by limiting Rx to cornea >400μ thickness.

- Pain
- Haze
- Failure of procedure
- Loss of 2> Snellen line
- HK, KU.

Results of CSR

- Intro of Results
  - Role of epithelium.

Date
DELTA Pg No.

Intraop Results

a) Epithelium → Epi probably fills in the valley around the cone & would be thicker where stroma is flatter

↓

Epi is thin at cone apex
Epi acts as smoothening agent, ↓ corneal power, astigmatism & irregularity of keratoconic cornea.

1mth Pos op
↑ parameter

6mth
↓ parameter

Paediatric KC

Changes of Cornea with Age →

Birth – 12 → Elasticity & ability to resist pressure
High Corneal hysteresis & resistance

12 – Early Childhood Reduction of elasticity & resistance of tissues
→ Susceptible to KC

Early – Late Childhood Much reduced : ~~Much~~ elasticity but ↑ rigidity through natural cross links resisting pressure

All pt baseline exam

- Topography
- Pachy
- Specular
- Dilated fundus exam
- IOP check

↓

Dx of KC

Age <18 | >18

<18: Mild | Advanced

Mild → Monitor 3 mthly → Progr (−) | (+)

(−) → Inadequate VA → Monitor Amblyopia → Spectacle correctn → CL → Intolerance → DALK/PK | INTACS

(+) → Offer CXL → Adequate VA → Monitor

Advanced → Offer CXL → Progression → Monitor

>18 → Progression (+) | (−)

(+) → CXL → Spectacle/CL → VA adequate | Inadequate

VA adequate → Monthly monitoring

Inadequate → INTACS | DALK

INTACS → Stable → Spectacle | Toric IOL

Future of CXL

Penetration Enhancer
Microneedles
Intrastromal channels
U.S.
Iontophoresis
Vacuum —— over baseplate
CL assisted CXL.
D_2O

- D_2O → ↑ CXL action
  Na. Azide → ↓ CXL. action

- CL assisted → riboflavin soaked, UV based free CL
- Penetration enhancement — BAC, Na EDTA, Tetracaine, Proparacaine, Ethanol, Gentamicin
  NC 1059 – ion channel forming peptide
  Merocel Sponge. (By producing sup abrasion)
  Cobra impregnated
- Intrastromal channels — using femtosecond LASER
- Iontophoresis — charged Riboflavin (Riccolin +) & 1mA current for 5 min
- Microneedle ≅ Intrastromal drug delivery
- Vaccum mediated —

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~~Aeno~~

Customized CXL

Dresden protocol

Pulsed CXL.

Accelerated CXL

Energy ↓ ↑

Thin Cornea.

Adapted fluence

Energy ↓

Additive procedure

LASIK Extra

→ Transepithelial

Epitheliotoxic drugs.

→ Iontophoresis

→ Smile/lenticule

→ CL based

→ Hypo-Osmolar — HPMC

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Other application of CXL

PACK-CXL → Photoactivated Chromophore for Keratitis
Corneal Edema
LASIK Ectasia.

Corneal Edema

glycerol 70% solution — dehydrate Cornea

Refractive Procedures

PRK → Photorefractive Intrastromal Cross linking
to ↓ level Myopia

LASIK Xtea

Application of CXL

Progressive Keratoconus
Post LASIK Ectasia
PMD → Paediatric pt.
→ Low grade Myopia — PRK
→ Refractive Sx
→ PACK

- PRK.
- Selected CXL for Axial myopia
- Over ~~the~~ donor Cornea in Kpro pro pt

PMD.
✓ CXL
↓
Intacs
↓
Tuck in keratoplasty

>40 yrs

Keratoconus
× CXL

PACK

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Microbicidal effect of UV light → Blue & Violet

Lupus Vulgaris ↓

↓ Microbial load in platelet aggre

Part of Neonatal Jaundice

No fluorescein staining before.

Effects

- Molecular
  - UV light
    - ↓
    - Direct damage by cross links b/t nucleic acids in RNA/DNA ∴ no pathogen replication
  - Photo activated Rb
    - ↓
    - ROS interact ⊆ nucleicacid & cell membs
    - ⇓
    - Type II rxn
- Macroscopic effect
  - ↑ resis to Enz digest^{n}
  - Transitory ↑ hypopy
  - ↓ pain postop

Progress of hypopyon in AC → local JH rxn to released bact endotoxins or attributed to reneteat^{n} of riboflavin in AC — that Intensifies local immune response

PMD vs TMD

Non inflammatory
Inferior

Inflammatory
Superior
✓ Lipid deposition
Vascularization +

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Corneal dystrophies

A group of progressive, usually bilateral, variable corneal opacifying disorders many of which are associated with ↓ vision & discomfort

Epi
- cogan
- Meesman
- Lisch epithelial dystrophy
- gelatinous drop like / subepithelial mucinous CD

Bowman
- Reis Bucklers
- Thiel Behnke

Stromal
- granular corneal dystrophy
  - Type I → classic
  - Type II → fuchs or combined GLD
- Lattice dystrophy
  - I
  - III — AR
  - gelsolin type
- Macular
- Schnyder (Crystalline)
- Francois Corneal cloudy d.

DM or Endothelium
- fuch's
- Post Polymorphous — AD
- CHED — AR
  - CHED1
  - CHED2 → + deafness → Harboyan syndrome

	Cogan	Meesman
	Map dot finger print	
Inheritance/ Onset	Sporadic » degenerat^n AD.	AD. Mutat^n in gene encoding C. Epi keratins
Histo	Thickening of BM & deposition of fibrillar protein b/t BM & Bowman. Basal epithelial cell hemidesmo are deficient.	irregular thickening of epi BM & intraepithelial cysts
Symptoms	2nd decade. 10% — Recurrent Corneal erosions Recurrent Corneal erosion ⊖ Trauma = BM. dystrophy.	Asymptomatic Recurrent erosions Blurring.
Signs.	Seen by retro-illumination • dot like & microcystic epithelial erosions • Subepithelial map like pattern surrounded by faint haze • Rhooted fingerlike line • Bleb like subepithelial pebbled glass pattern.	Myriad tiny intraepithelial cysts of uniform size & variable density — maximal centrally & extend towards but do not reach limbus – Slightly thinned Cornea & ↓ sensation
Rx	↓ Recurrent Corneal Erosions	

	CBD I Reis Buckler	CBD II Thiel Behnke
	Ant variant of granular stromal dystrophy / TGB Type 3 Corneal BM dystrophy (CBD_1)	Honeycomb shaped ↓ sevece CBD II
Inheritance	AD. gene — TGFBI	AD TGFBI
Histo	Replacement of Bowman by connective tissue bands	Curly fibres on EM
Symptom	Severe Recurrent Corneal erosion in childhood Visual impairment +	Recurrent erosions in childhood
Sign	Grey white geographic Sub. epi opacities — dense centrally → ↑ density & age tdl form Reticular patteen. ↓ Corneal sensation.	Subepithelial opacities ↓ defined develop in network of tiny rings or honeycomb like morphology — Involv^n central cornea
	Excimer Pf seq.	^ Necessary

Lattice Corneal Dystrophy

LCD II

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Introduction	classic form TGF β1	Gelsolin type. Meretoja Syndrome >> Systemic Condition
Inh & Inheritance	AD	AD gene GSN
Histology	Amyloid, staining ⊆ Congo red. exhibiting green birefringence ⊆ polarizing filter	Amyloid deposit.
& Symptoms		Ocular Irritation & late impairment of vision.
-	Recurrent Erosion.	
-	Blurring occur later.	
Signs. -	Refractile Ant stromal dots ↳ relatively fine fil. lattice that spreads gradually & space periphery ↳ generalized stromal haze	Sparse stromal lines spread centrally frm periphery Impaired Corneal Sensation. Progressive Corneal & Peripheal neuropathy. mask like face
-	Corneal sensation reduced	
Rx	ALK, PK. ↓ Recurrence	Keratoplasty may be required.

	granular Type I	granular Type II
Intro		Avellino. Combined granular lattice dystrophy
Inheritance	AD. TGFBI	AD TGFBI
Histo	Amorphous hyaline deposit staining bright red ⊆ Masson trichrome	Hyaline & Amyloid
Symptoms	glare & photophobia bursting Recurrent erosions	Recurrent erosion tends to be mild. Visual impairment - late feature
Signs	- discrete white Ant corneal stromal deposits resembling bread crumbs seperated by clear stroma → gradual ↑ in size & no. ⊆ deeper & outward spread sparing the limbus - gradual confluence & diffuse haze - ↓ corneal sensation	fine superficial opacities - progress to form stellate or Annular lesions ⊆ deeper linear opacities
Rx	DLK, PK, Excimer.	Rx not req, Corneal trauma ↑ progression × Refractive Rx

	Macular	Schynder (Crystalline)	Fearcoi's Central Cloudy
Introduct"	Recessive Common.	Disorder of corneal lipid metabolism ass ⊆ systemic dyslipidaemia	↳ Posterior Crocodile shagreen
Inheritance	AR CHST6 » Iceland	AD + UBIAD1	AD.
Histology	Aggregation of GAG intra & extracellular + stain ⊆ Alcian Blue & Colloidal iron	Phospholipid & cholesterol deposits	
Symptoms	Early visual deterioration. Recurrent erosions	Visual impairment & glare	None
Signs	Dense, poorly delineated greyish white spots centrally in Ant stroma. Peripherally in post stroma * clear delineat" of opacities Progression of lesion ⊆ stromal haze full thickness stroma involve" ⊆ no clear zone Thinning is early feature ⊆ late thicke" due to edema	Central haze. ↳ full thickness. Subepi crystalline opacities Progressive Corneal arcus. Gradually progres centrally	Cloudy greyish polygonal or rounded post stromal opacities, most prominent centrally.
Rx		Excimer keratectomy & Corneal transplant	Not req

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stages diff

Fuch's

Move details on next pages

CHED DELTA Date Pg No.

IBO CHED 1 | CHED 2

Introduction Bil accelated endothelial cell loss
>> ♀ >> POAG

Inheritance Sporadic. AD
COL8A2

Symptoms Gradually worsening blurring —— >> morning due to corneal edema

Signs Corneal guttata — Excrescences on DM secreted by abn endothelial cells
→ Specular — tiny dark spots caused by disruption of regular endothelial mosaic
↳ beaten metal appearance
→ Endothelial decompensation
– Corneal stromal edema — blurred vision – worse in morning.
– Epi edema >> adv case
formatn of microcyst & bullae
pain if bullae burst.
– Subep scarring & peripheral Vascularization

Rx
- Hypersol. ↓ IOP, Hair dryer
- Ruptured bullae — BCL, Cycloplegic, AB, lubricants, Ant stromal puncture
- Post lamellar — DSEK, DMEK

focal or diffuse thickening of DM & endothelial deg

CHED 1
AD – Chr 20
↳ PPCD
>> Photophobia
Watering
1-2yrs
Corneal clouding
Nystagmus +
⇒ VI >> Corneal appearance

CHED 2
>> Common
>> Severe
+ deafness — Harboyan syndrome
AR.
SLC4A11
Neonatal

DALK or PK.

PPCD

3 forms

ass ≤ Iris Atr
glaucoma
Alport syndrome

AD. VSX1 COL8A2 ZEB1

Absent.

Subtle vesicular band like, diffuse endothelial lesion

defect	4th protein, hyaline deg of collagen	4th protein, 1° Amyloidosis of cornea	Metabolic – defective acid MPS metab 181 DELTA localized MPS.
	granular	Lattice	Macular
genetics	AD	AD	AR
onset	Early adolescence	1st decade of life	1st decade
vision	good until middle age	Early ↓ & obvious clouding by 20yrs. 6/60 @ 50yrs	↓ by 30-40yrs. CF by 50yrs
symptoms	↓ inflammation & irritation	Severe recurrent erosion	Mild recurrent erosive symptoms
opacities	greyish opaque granules Bread crumb sharp borders	Grayish pipe cleaner, linear branching threads, dots & flakes distinct borders	Grayish opaque spots, indistinct borders ↓ CT in AS OCT
intervening stroma	Clear	Rel. Clear	Diffuse cloudy
distribution of opacities	Axial only periphery clear	Entire Cornea & dots linear central opacities periphery – clear Progress to central disc from by middle age	Entire Cornea to limbus at most dense centrally
histopath	discrete hyaline granulated	Large hyaline lesion & scattered fibrillar material; also subepi	Diffuse, granular Nbl hyaline material ass & keratocytes
Histochemistry	Masson Bright Red. PAS neg	Masson Red purple PAS +ve Congo Red + Birefringent, 2 colour dichroism, Thioflavin T fluo	Colloidal Iron +ve Alcian Blue +
Microscopy	Rod shaped, c⁻ dense, crystal str (Bio-Sing). keratocyte Normal, Endothelium (N)	Random fibrils. c⁻ dense Keratocyte – (N) Endothelium (N)	Diffuse vesicles fibrillar material in stroma, BM keratocytes & endo distended by Memb bound vacuole & fibrogranular material

100. ICVD classificat"

	Dysteophy	Gene	Mutations
Cat 1	Well defined	Gene mapped	known Fuchs CHED 2, PPCD 2, 3
Cat 2	✓	Chromosomal loci ✓ gene × mapped	CHED 1, Lattice PPCD 1; X
Cat 3	✓	✗ ✗	Fuch's Procedu
Cat 4	Not identified.		Be DM dystroph

Fuch's
- Def
- Inheritance < Early / Late
- Symptoms
- Signs → Stage I / II / III / IV
- + Cataract
- Ix,
- D.D. (Chart)
- MX,

MX → Cataract
MX → Edema
MX → Recurrent

Congenital Corneal Abn

- Sclerocornea
- Megalocornea
- Cornea Plana
- Posterior keratoconus
- Keratectasia
- Sclerocornea.

genes in KC

ZNF469 — sporadic

SOD-1
TGF B1
USP1 gene.

> Inflammatory processes

KC

& VKC
NO Eyerubbing
Counsel

↓
BCVA
↓
CL Trial

— Progressive + → ↓

Young age
Hydrops other eye
VKC
x follow up
↓
CSR at presentation

Old
↓
BCVA

Satisfactory
↓
CL or spectacle
↓
Progressive
↓
CSR

x or Poor CL tolerance
ICRS
DALK | PK

Possible
CXL
↓
>400 Epi off
↓
Doesden

CXL + PRK/ICRS
<400
↓
HPMC
Hypo-Osmolar
x Dextran

CXL ± ICL
↓
↓ regular Astig

x possible
↓
Vision ≤ CL

Satis
↓
BMT
↓
CL

x
↓
DALK/PK

Hydrops Large
↓
PK

Small
↓
DALK

x Hydr
↓
DALK
Big bubble

Trigeminal N Br

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V_1 — Ophthalmic
- Lacrimal
- Frontal
- Nasociliary
  - Long ciliary N
  - Post ethmoidal N
  - Infratrochlear N
  - Ant ethmoidal N

V_2 — Maxillary N
- Middle Meningeal
- PP
- Post SAlp Alv N
- Infra orbital
- Zygomatic.

V_3