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Std. Div. Roll No.

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Congenital Anomalies of Lens

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- Coloboma of Lens
- Congenital ectopia Lentis
- LentiConus / Lentiglobus
- Congenital Cataract.
  - Microspherophakia / Microphakia
  - Mittendorf dot

(a) Coloboma of Lens

focal inferior flattening or truncation of Lens in lower quad of equator resulting due to absence of zonular support.

Unil. Hereditary
Double coloboma of Lens
VA ± ↓
Slit lamp exam — confirms the diagnosis

Rx → RE Mx
Amblyopia Mx
Cataract Sx

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Lenticonus

Cone shaped projection

- Ant pole → Alport's
- Post pole → Lowe's

Features — ↓ VA. — Myopia, Amblyopia

Strabismus

Nystagmus.

- Oil drop sign +ve
- Dilated fundus exam.
- L. Opacification

Rx — RE correction

Phaco-aspiration & IOL implantation

(*) do Posterior Capsulorrhexis in Post Lenticonus pt. also in Paediatric Cataract?

Lentiglobus

globe shaped bulge.

- A — 10% — Bilateral
- P — 90% — Unilateral

- Ass glaucoma.
- L. Opacity.
- USG A scan — ↑ LT.

Mittendorf dot

small white dot on post Lens Capsule — remnant of Post tunica Vasculosa → former hyaloid artery attatched

Asymptomatic.
ass ⊆ PPC.

Microspherophakia & Microphakia

Microspherophakia → Small Spherical

- familial → AD.
- Weil Marchesani
- Marfan's
- Peter's Anomaly.
- Hyperlysinemia.
- Alport's
- Congenital Rubella.

Microphakia → Shape ↓↓ Size → Small. Biconvex ↓ Lowe Syndrome

C/F — R.E.
Amb.
Subluxation of Lens.
PBG / Inverse / Glaucoma
- Aggravated by Miosis
- Relieved by Mydriasis

Rx — RE treat.
PBG — relieved by Cycloplegics

BIOMETRY

Guess work approach → IDEM lenses
Standard "
Emmetropic "

IDEM lenses → Natural lens = 23.7D
approximately 6mm behind Cornea
As PCIOL is ant ∴ 20D

Standard lenses → 2D > IDEM ∴ 1.5D Myopia

PCIOL → +22D
ACIOL → +20D.

Emmetropic Lens → (RE × 1.25) = a
IDEM lens + a of hypermetrope
− a of Myope.

Power of different IDEM lenses

- L → +17.0D
- Iris
  - Clip → +18.1D
  - Plane → +19D
- PCIOL
  - Ant Convexity → +20D
  - NP → +21D
  - Post Convexity → +22D

Biometry

- Keratometry
- AL.
- effective IOL position

a) Keratometry

- Keratometry
- Pentacam
- Galilea.

to do it first, Novel procedure

Re-measure if → CC <40D >47D
diff of cylinder ID B/t eyes
Corneal cylinder ≠ Refractive cylinder

b) AL → AL = 23.5mm

↓

1mm error = 2.35D error.

- Usg
  - Applanation.
  - Immersion Tech
- Optical
  - ↓
  - ½ Coherence based Infrared light

A Scan;

Take reading of largest ACD

c) Effective lens position →

- Anatomical
- IOL related
- Surgeon related
  - Bag to Sulcus - (0.50-0.

IOL Master

ISD

Formulae for calculating IOL power.

- First — ELP - 4mm
  - Binkhorst.
  - Colenbrander-Hoffer.
  - Gill's
  - Clayman
  - Fyodorov.
- Second. — ELP α AL
  - Modified Binkhorst
- Third. — ELP α K & AL
  - Holladay-I
  - Holladay-II
  - Hoffer's Q.
  - Haigis
- Fourth — preOp ACD, LT
  - Holladay-II
  - H. Consultant IOL programme
  - Refractive ∫
  - SRK-T.
- 5th gen
  - New
    - Hoffer H-5.
    - Barrett's Univ II
    - Olsen fig
    - IOL / Capsular Bag
    - Hill RBF

Refractive — based on geometric Optics

SRK-I

SRK-II

Modified SRK-II

Super ADB Kane formula. Ray tracing

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Drawback of Theoretical formula.

- Predict too large in short eyes & vice versa
- Cumbersome
- Guess abt ACD req.
- developed during Pmma supported lenses era
- Theoretical assumption (Schematic eye)

Vaiable in theoretical formula

- Net Corneal power (K)
- Axial Length (AL)
- IOL power
- Effective Lens position
- Desired Refraction (D Post
- Vertex distance (D)

SRK formula. Sanders Retzlaff Kraff.

$$P = A - 2.5L - 0.9K. \quad \left(-\frac{Rsy}{Rs}\right) \text{ in SRK II}$$

AL. 22 – 24.5mm.

Rs - Desired post op

y → 1 for AI < 1.4
1.25 >

∴ too small value in small eyes too large
large

SRK II		Modified SRK-II
A + 3	< 20	A + 1.5
A + 2	20 - 21	A + 1
A + 1	21 - 22	A + 0.5
A	22 - 24.5	A
A - 0.5	24.5 – 26	A - 1
	> 26	A - 1.5

SRK-T >26 mm
Optimized for Post op ACD, RT, Corneal RI.

Optimization ↑ accuracy of formula.
by altering & refining manufacturer's lens constant

Gen guidelines

<24.5	24.5 – 26	> 26
Hoffer Q SRK-II	Holladay I	SRK-T.

← Barett's for all (Universal)

Errors

- AL
- Corneal power.
- ELP — 1mm = 0.5-2.5D
- Error from formula used
- Manufacturer labelling error

Biometry in special situations

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Aphakic eyes

∂° IOL calculation

light speed — Aphakic — 1532 m/s
Pseudo — x.
Cataractous — 1550.

× 2 lens spike only 1 retinal spike.

∴ Immersion tech best.

Pseudophakic Eyes

- Amm ← reduplication of echoes.
- If setting same. then AL ≠ TAL = AAL
- special Holladay formula for pseudophakic Biometry.
- for piggyback IOL
  - Holladay refractive formula.
  - Gill's Nomogram.

In Vitrectomized eye.

↑ gain

formula by Professor John Shammus

$$TAL = \frac{1133}{1550} AAL.$$

(AAL: apparent)

Usually req. 2-3D stronger lens.

velocity of sound slower in vitreous

neg lens.

Hyperopia by 2-3D.

∴ ↑ IOL by that

In Post keratorefractive Sx.

- Instrument error
- Index of RE. — As Manual Keratometer measure only Ant Curvature
- Formula Errors

20 Methods

1) Calculation Method
2) Trial Hard CL
3) Corneal topographic / Keratometric
4) IntraOp Retinoscopy
5) DBR
6) Feambelli double k.

Calculation Method → Most accurate.
Require pre-Op K readings.

Reading ↷ SE ↷ at spectacle plane ↷ deduct them.

Trial Hard CL method
Normal refract^n
" ≤ Hard CL

SER = previous : K = Base Curve
Myopic shift : <
Hyperhetropic : >

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Corneal topography/ keratometry method →
Change in postop K reading, undercorrect by 14% to get accurate post op K reading.

↓

Else hyperopic result

A-P = 1.2mm of cornea

1D change = 14% change induced.

IntraOp Retinoscopy method →

DBR Method →

0.7D change at spectacle plane = 1D change at IOL plane

$\frac{\text{PreOp Ref}}{0.7} = \frac{a}{\text{PreOp IOL} + a}$

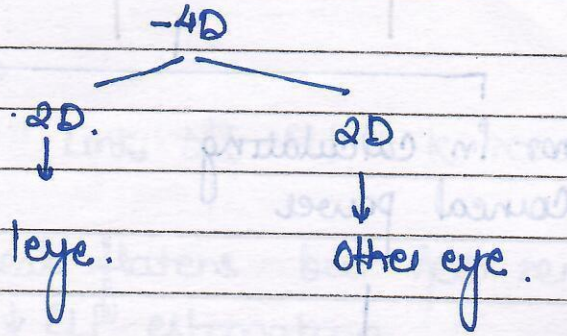
Aramberri double K Method

Pre Op K Corneal power — ELP
Post " — IOL power calculation

(*) Use >1 formula.
Never use Regression formula

Final IOL power Calculation →

a) fellow eye refraction & Cataract



b) Lifestyle of pt.

c) Hedging — Try keeping pt Myopic.

Biometry in Post Refractive Sx Patients.

Sources of error in post refractive Sx Eyes

- Error in calculating Corneal power
  - a) Power of C. apex = 45D which is measured by Keratometry
  - b) K = 1.3375 (fixed value) presumes constant ratio b/t A & P surf.. Combines the two curvature into one
    - ∴ Keratometer measure by estimating ant Corneal power.
    - Bt following LASIK/PRK Ant surf is flattened & post remains unaltered.
    - ⇓
    - Source of error
- Error in ELP (Effective Lens Position) estimation.
  - C. power measured by keratometer in paracentral cornea rather than Central. Normal is steeper at apex ∴ judging of curvature is done to estimate central apical power.
  - Now post Sx center is flat bt it is missed as measurements taken in paracentral area.
  - 2nd source of error.

Logic reverses in hyperopic LASIK & Thermokeratoplasty for hyperopia done.

Overestimation of Central Corneal power
⇓
IOL power ↓
∴ Post op hyperopia occurs

Error in ELP estimation – 3rd gen formula use Corneal curvature to estimate Corneal vault

↓

estimating ELP

∴ Link b/t ELP & K readings

In Myopia → Corneal flatens but ACD remain same

∴ ↓ ELP estimation

i.e Anterior projection of IOL

↓

Underestimation of IOL power

How to tackle this error →

a) Haigis formula is not affected as it uses actual ACD ∴ ✓ Works in Post refractive Sx patients.

Haigis L. → Myopic Sx

b) Double K Modification → Uses 2 Variables

Vergence Equation

↓

Dioptric influence of C. curvature on IOL power estimation

↓

Post op K used

ELP estimation

↓

Pre Op K to estimate ELP

Idea proposed by Aramberri. Not inbuilt but software available.

If PreOp K not available
taken as 43.5 D

⇓

No History double K approach.

How to tackle error of Corneal power Calculation

|

- Using historic data. to get C. power right.
- Adjusting K index using historic data.
- Getting C. power right without historic data.
- Other Method

(a) Getting C. power right

- ⊆ historic data.
- ⊆ out historic data

a) Clinical History Method (CHM)

Measure Corneal power + Refractive Correction

$K_{CHM} = K_{Pre} + Ref\ change$

b) Ronje Method
No PreOp value req.

$K = K_{present} + 0.25 \times Ref\ change$

» Post LASIK Eyes.

a) Contact Lens Method
Placing hard CL of 0 power does not change manifest refraction if Base Curve = Corneal Curvature (C)
(BC)
If BC > C = Myopic shift
< Hyperopic

c) Adjusting K index using historic data
- Savini Method
- Camellin
- Jaiade Method → Post LASIK eyes
  - req knowledge of refractive change by Sx
  - Avg radius of Curvature of cornea at present

(d) Other Methods » Myopic LASIK.

a) Maloney Central topography

$K = 1.114 \times \text{Topo } K - 5.5$

b) Koch & Wang → 6.1

c) ~~Shammas No History~~ Savini et al → 4.98

d) Shammas No History → Manual reading method.

(*) Theoretically the best way is to record Ant & Post curvatures at C. apex — ~~not~~ seperately using Scheimflug Imaging.

Methods

Requiring clinical History

a) Feiz Mannis formula

$$\text{IOL power} = \frac{\text{Power (Recop)} - \text{Refractive change}}{0.7}$$

b) Market Method recommend

- > 23 → Holladay I
- AL.
- < 23 → Hoffer Q.

Not requiring clinical History

→ IntraOp abberometry
e.g. ORA / Optiwave Refractive Analysis att to operat^n scope

→ HOLOS IntraOp latest wavefront abberometer

Tanchuler Method
↓
Aphakic correction on the OT table.
using autoref hand held

Not Economical

Mackool 2° IOL Implant method
↓
~~Shifting~~
Cataract Sx
↓
Out of OT for refraction
↓
Back to OT for 2° IOL Implant

Post Refs Sx.

Based on Source of error.

- Error in Calculating Corneal power
  - Getting Corneal power right
    - ≤ historic data.
      - a) CHM
      - b) Ronje method
    - without data. historic
      - a) Contact Lens method.
  - Adjusting K index. using historic data
    - Savini
    - Camellin
    - Jalade
  - Other Method
    - Maloney Corneal topography
    - Koch & Wang
    - Savin et al
    - Shammas No history
    - Scheimflug Imaging
- Error in Calculating ELP.
  - a) Hafgis formula
  - b) Haigis - L
  - c) Double K Method
  - d) No History Double K.

Based on Method

- Clinical history →
  - Required ←
    - Feiz Mannis
    - Masket Method.
  - Not required
    - Mackool 2° IOL.
    - Ianchuler Method
    - IntraOp Aberrometry
      - ORA.
      - HOLOS.
    - ASCRS Website.

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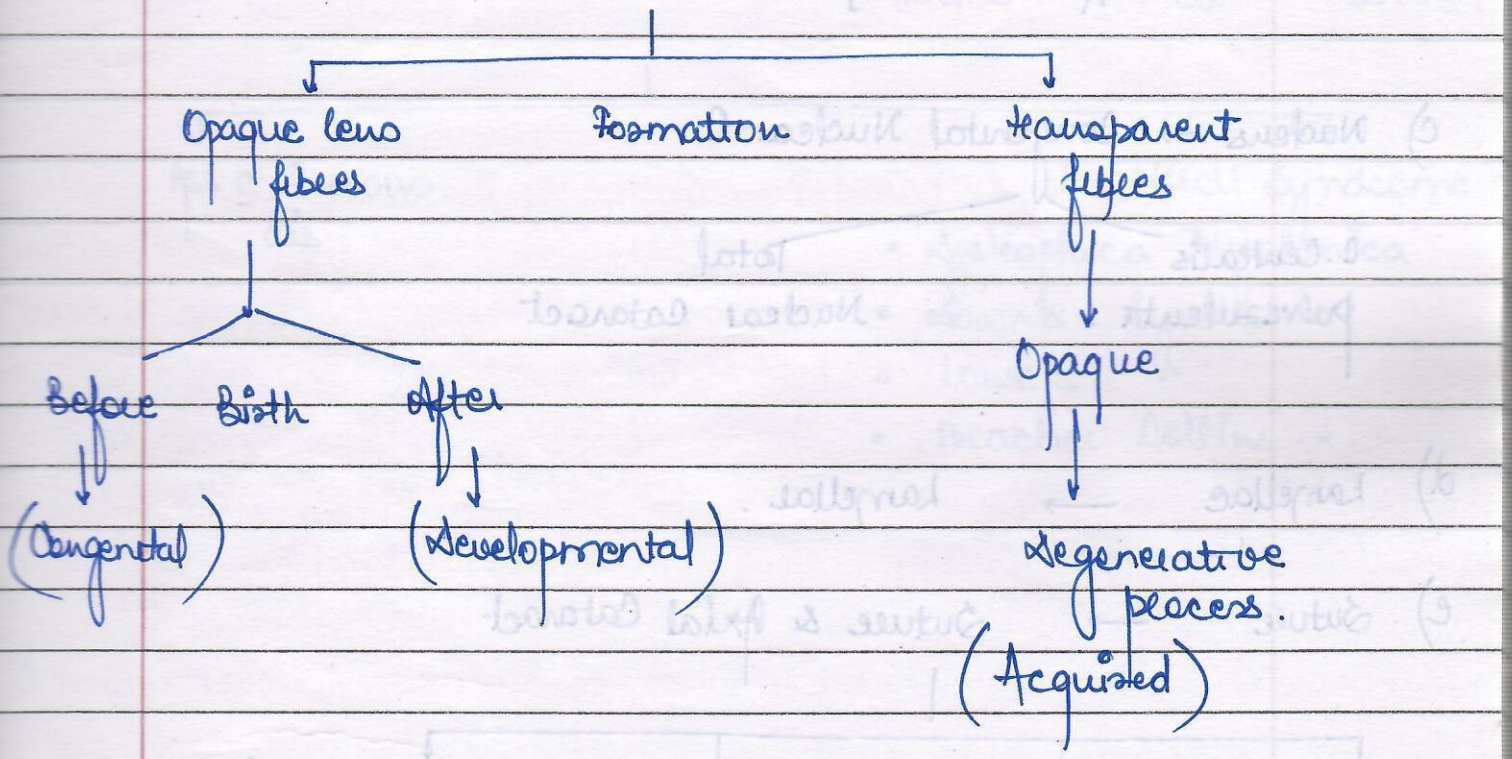
Cataract

Kataraktes → Waterfall

Constantinus — Suffusion → Something deposited over something else.

Lolfinack → Any opacification in lens or its Capsule

Clinically as mentioned in Medical Dictionary of Saunders → Opacification of sufficient severity, on or in human lens or its capsule to impair the vision.



Classification of Cataract

(a) Etiological

- Congenital
- Acquired

a) Capsule → Congenital Capsular C
   - A
   - P.

b) Polar → Polar
   - A
   - P.

c) Nucleus → Congenital Nuclear C
   - C. Centralis pulverulenta.
   - Total Nuclear Cataract

d) Lamellar → Lamellar.

e) Suture → Suture & Axial Cataract
   - Fusiform
   - Coralliform
   - Spear shaped
   - Ant axial embryonic C.

f) General → Generalized
   - Coronary
   - Blue dot
   - Total Congenital
   - Congenital Membranous C.

Acquired

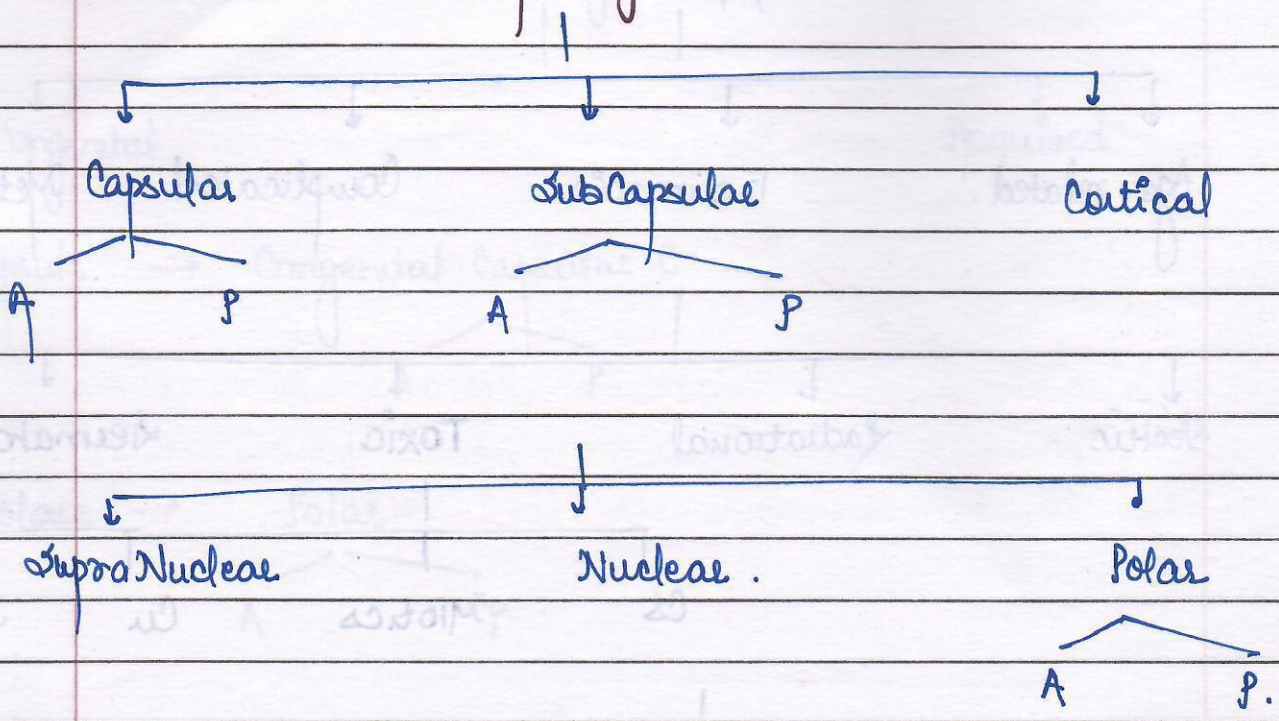
- Age related.
- Traumatic
- Complicated
- Metabolic

- Electric
- Radiational
- Toxic
  - Cs
  - Miotics
  - Cu
  - Iron.
- Dermatogenic.

Ass ⊆ Osseous dis

⊆ Neuromuscular Syndrome
- Dystrophica Myotonica
- Down's Syndrome
- Lowe's
- Treacher Collins

(b) Morphological



(c) Based on Stage of Maturity

(a) Stage of Lamellar Seperation — demarcat^{n} of lens fibres owing to sep by fluid

(b) Stage of Incipient C → Early or mild changes of Lens opacificat^{n}

(c) Immature C → Scattered opacity

↓ (+) Swollen by imbibat^{n} of fluid → Intumescent C

(d) Mature C/Riped C → Total opacificat^{n}

(e) Hypermature C

Morgagnian.
↓
Total liquefact^{n} of C. Cortex

Sclerotic type
↓
Shrinkage of opaque lens & Wrinkling & thickening of Ant lens Capsule

Cataract classification systems

- In Vitro.
  - American Cataract classification & research group (CCRG)
- In Vivo
  - LOCS
  - Penta Cam. scheimpflug based.
  - OCCCgs
  - Wilmer.
  - Wisconsin
  - Japanese Co-operative
  - WHO classificat"

LOCS (Lens Opacities classification System)

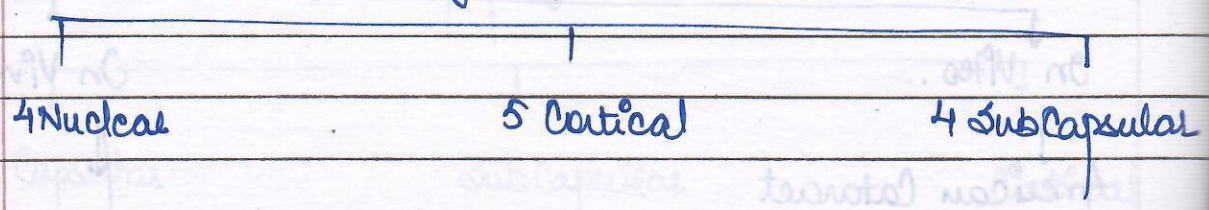
- Extent of Opacificat"
  - Cortical
  - Post Subcapsular
    - 8½ inch × 11 inch ≤ pt pupil maximally dilated.
- Intensity of Nuclear Opalescence
  - behind pt light shoulder

	LOCS I		LOCS II	LOCS III
0 →	x Lens Op		N4	N6
1 →	Early Op	1a – Minor	C5	C5
		1b – Early Cortical C	PSC 4	P5
2 →	Definite C.			

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LOCS II

for Long studies



LOCS III — 4 features



6 6 5 5

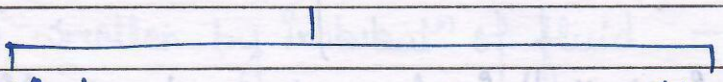
Wilmer

NO *NC C P

4

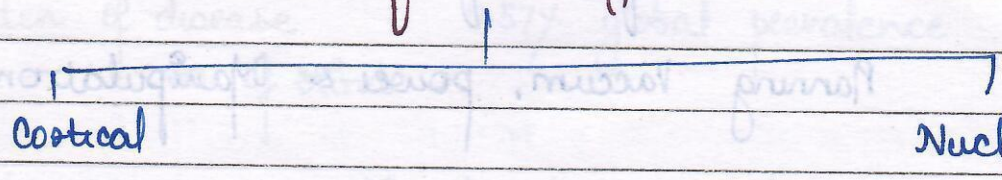
Oxford

0-5 Scale



Ant clear Zone.
Diameter Scale
Pie Segment
Vacoule
Retrodot
Focal dot

Japanese Co-operative Cataract epidemiology study grp classification system



Early – grade I
Moderate – II
Advanced – III

I – pale yellow
II – yellow
III Brownish "
IV Brown.

World health Organisation's Simplified Cataract grading system.



PSC
feathery appearance as opposed to spoke like opacities

grade 0 – <1mm
1 1-2mm.
2 2-3mm
3 >3mm
9 – Cannot grade.

Optical Biometry Based Cataract grading System (OBBCGS)

NC — No C — Locs III NO C0 P0
OBEC – Optical Biometry Examinable C NCP (1-3)
OBUC – " " Un " C NCP (4-5)

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Adv — OBEC – for beginner
L Befeled for research

Planning Vaccum, power & Manipulation

PentaCam based Schiemflug System

Epidemiology of Cataract

48% of all blindness → 90% of blind in develop^{n}.

Burden of disease — 0.57% global prevalence

No. of blind

Vision 2020 → Aim to prevent Avoidable blindness by measuring CSR

Ephasis on —:

a) ↑ success rates
b) Affordable & accessible services
c) Measure to overcome barriers & ↑ use of services

Indian Scenario — largest Cause of B.

62% of >50yr → C.

As per RAAB. — Rapid Assessment of Avoidable B

72% in >50yrs.

Obj & targets — Under Vision 2020

CSR — 4500 million — 2005
5000 " — 2010
6000 " — 2020

- Outcome — >6/18
- IOL Sx — 100% by 2010
- YAG cap in all ~~centers~~ district hospitals by 2010

Str activities

1° screening (PC < 6m)
Case selection — screening level/Base level
Cataract extract^{n} & IOL implantation
Reduction in disparity.

Impact of dis →

Outcome & EQL → In USA ↓ results in other →
surgical complicatn
Concurrent disease
Loss of aphakic spectacles
development of PCO.
Even Improves depression.

Risk factors → Age
Smoking
UVB radiation
Diabetes.

Conflicting — Race.
Myopia
Nutrition
Wt status & fat consumption
CS
Exogenous Estrogens
Genetics
Markers of Inflammation

Various studies

AREDS

∝ reliability on classifying Cataract ∝ AREDS

Beaver Dam eye Study

Visually signi → 38.8 y. ♂
45.9 y. ♀

Incidence of Nuclear 13.1 %
Cortical 8.2 y.
PSC 3.4 y.

Sex distribution ♂ > ♀

Baltimore eye study

Leading cause of blindness >40 yrs

Racial difference

Longitudinal study of Cataract

Loss III def.

R/f for Nuclear C

→ ↑ age
→ White race
→ ↓ education
→ gout medicat"
→ Current smoking
→ family H/O Cataract
→ Pre-existing DSC

Barbados eye Study

Cortical opacities Women >>.

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Acquired Cataracts

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Types

- Senile
- Traumatic
- Metabolic
- Complicated
- Drug Induced
  - Cs
  - Miotics
- Radiational
- Electric
- Syndermatotic C. ass. with skin disease
- C ass. with Osseous disease
- C. with musc. syndrome
  - Dysteophica Myotonica
  - Down's
  - Lowe's
  - Treacher Collins

C. with Systemic disease

- Diabetic
- Parathyroid tetany
- Myotonic dysteophy
- Galactosaemia.
- Down syndrome
- Atopic dermatitis

Age Related Cataracts

Senile C.
Commonest type.
Bilateral

- Cortical
  - Soft
    - Cuneiform
    - Cupuliform.
- Nuclear
  - Hard.

Etiology

Risk factors

- Age — <45 → Presenile C
- Sex — ♀ > → Longer life span, Hormonal changes, Other factors
- Heredity — 50% C, 35-50% — N
- Ultraviolet Irradiations → PSC > 290-320 nm & lens Opacification
  - Oxidative events
  - Try → (UV) → N formyl Kynurenine → 3OH → free radicals
  - regulate fxn of Na^+/K^+ ATPase
    - Lens swelling
    - Opacification

Photo-oxidation ↑ O_2
↓ Vit E, Vit C, glutathione

- Dietary factors → Protein, aa, Vit
- Dehydrational crisis
- Smoking → Accumulation of 3OH kynurenine
  ↓
  Chromophores
  ↓
  leads to yellowing

Cyanate in Smoke → Carbamylation.
Protein denaturation

Causes of Pre-Senile Cataract < 45yrs

- Heredity → Antiapation
- DM → Nuclear
- Myotonic Dystrophy → PSC
- Atopic Dermatitis

Mech of Loss of Lens transparency

- Nuclear → ↓ Protein
- Cortical

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Cortical → ↓ in lens proteins & free a.a

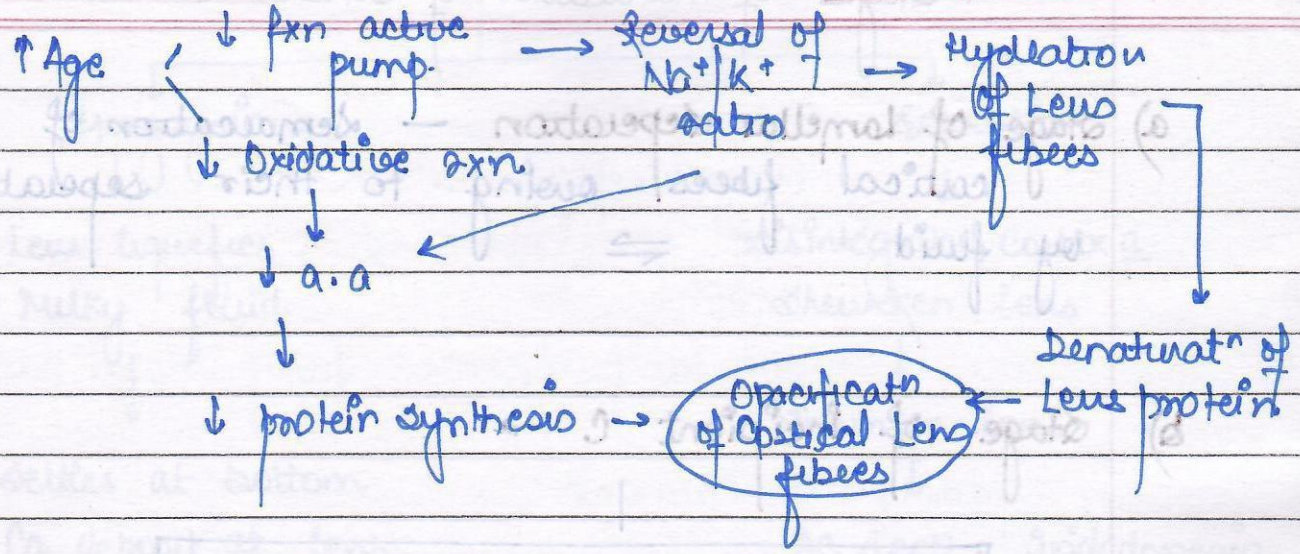
- H_2O Content
  - H_2O responsible for hydration of extracellular
- Protein Content
  - Total ↓
  - Insoluble ↑
  - Loss of α Crystallins
  - γ "

Reason for ↓ soluble protein

- Leakage of ↓ MW 4m lens into surrounding
  - ↓ free a.a.
  - Na ↑ K ↓
  - Ca ↑
- ↓ GSH
  - ↑ ONOO
- ↓ Synthesis
- ↑ Catabolism

Salit classificatn

	Incipient	Immature	Mature
Ca^{++}	<10 mg%	10-35 mg%	>35 mg%



Role of Vit C & glutathione in C.genesis

Highly reactive Superoxide ⟶ ↓ reactive H_2O_2

↓ glutathione in Cataractous lens
- ↓ Synthesis
- ↑ permeability to reduced gluta
- defici of Enz glutathione reductase

Stages of maturation of Senile Cataract

a) Stage of lamellar seperation — demarcation of cortical fibres owing to their seperation by fluid ⇌

b) Stage of incipient C →

- Cuneiform → Wedge shaped → » Lower Nasal Quad
- Cupuliform → Saucer shaped

Peri → Centre ∴ late visual disturbances — early

c) Immature Senile C → opacification → » diffuse & Irregular

↓

Swollen lens ⇒ Intumescent C.

↓

AC shallow.

d) Mature Senile C → Pearl white. , Ripe Cataract

e) Hypermature Senile C →

Morgagnian → Lens liquefies → Milky fluid → Settles at bottom → Ca deposit at lens capsule

Sclerotic → Disintegrated Cortex & Shrunken lens → Shrunken lens → AC deep. Iridodonesis

Maturation of Nuclear C

Cloudy (greyish) → Tinted (yellow & black) → Amber

Amber → Brown (Cataracto brunescens)

Brown → Black (C. nigra)

Black → Reddish (C. rubra)

Cf
a) Glare → PSC & Ant lens Opacities
b) Uniocular diplopia / Polyopia. →
c) Coloured haloes
d) Black spots in front of eyes
e) Image blue, distortion of image
f) Loss of vision

Central Opacities → Cupuliform. PSC → Day blindness

& peripheral opacities → Cuneiform → Bright light Contracted pupil] » 2nd sight

Nuclear Sclerotic C → Progressive index Myopia → 2nd sight

↑ Opacification → PL + ve.

Signs
- VA
- PS
- Oblique illumination test.
- Test for Iris shadow — Immature C
- DDO
- Slit lamp Exam — fully dilated pupil

grading of Cataract

DoD

ISC		Nuclear Sclerosis
Painless progressive DOV		
greyish colour		
+	Iris shadow	-
+	Black spot on Red glow	-
Cataractous Lens	Slit lamp	Clear lens
Improve	VA ≤ pinhole	x

MSC		Leukocoria
Normal	Pupil	Semi dilated
x	Purkinje	✓
Cataractous (N)	slit lamp	usually clear
	VA ≤	Vitreous opacities

Complications

- Phacoanaphylactic Uveitis
- Lens Induced glaucoma
  - Phacomorphic
  - Phacolytic
- Subluxation / dislocation — Phacotopic

Sugar/ ~~Diabetic~~ Cataract

Diabetic | Galactosaemic.

True Diabetic

↓

Snow flake C
Snow storm C

↓

Osmotic Overhydration of lens due to accumulatn of Sorbitol

↓

glucose metabolised by aldose reductase

↓

fluid Vacoule underneath Ant & Post Capsules

↓

Snowflake like white opacities in Sup & post lens Cortex

↓

Intumescence.

Senile C

Accumulation of Sorbitol c in lens

↓

Acc chages in hydration

↓

↑ Non Enzyme glycosylation

glycation of Lens protein

↓

greater Oxidative steers frm alteration in Lens Metabolism.

Galactosaemia

Classical | def of galactokinase

Oil droplet Central Lens Opacities

↓

Reversible if milk eliminated frm diet

Pathogenesis of Sugar Cataract

Sorbitol, Aldose reductase & Osmotic hypothesis

Excess sugar
↓ Aldose reductase
Sorbitol
↓ Polyol DH
Fructose.

Sorbitol, galactose, Dulcitol
⇓
Can't leave the lens ∴ accumulate
↓
Hypertonic

- Large move^{n} of H_2O into lens
- Alt of Na^+ | K^+ ratio
- Concomitant lens swelling

⊖ F.A, Tetramethyl glutamic acid, Flavanoids, Synthetic Compound
- Aldestatin
- Sorbinil

Hypothesis of Auto-oxidation of Sugars

Theory of Non Enzymic glycosylation

Glycation
↓
Attack of open chain form of sugar on amino form of lens proteins
↓
Conformational alterat^{n}
- Thiol Oxidation
- disulphide format^{n}

(b) Hypocalcaemic Cataract

Infantile Tetany

Idiopathic. → Hypo Ca. ← Hypoparathyroidism due to atrophy

Ca^{2+} → Memb integrity

∴ lead to Memb disruption, ↑ permeability resulting in lens fibre opacification.

Infantile	Adults
- Zonular Cataract.	- Bil multicoloured flecks in Ant & Post Cortex
- Thin Opacified lamellae deep in infantile Cortex	

Lowe Syndrome

Oculo-Cerebral-Renal . X linked recessive

a.a metab

- Ocular
  - Congenital Cataract
    - Glaucoma
    - Blue Sclera
  - Small Lens
    - Cataract
      - Capsular
      - Lamellar
      - Nuclear
- Systemic
  - Mental Retardat^n.
  - Dwarfism.
  - Osteomalacia
  - Msl. hypotonia
  - Frontal prominence

Myotonic Dystrophy

Myosin gene defect . AD.

- Systemic
  - delayed relaxation of contracted Msl.
  - Cardiac Conduction defects
  - Proximal frontal baldness in ♀
- Ocular
  - Ptosis
  - Cataract
    - ↓
    - Cheistmas tree
    - Pe-Lenle C.

Error of Metabolism

(Cu)

Wilson's Disease (Hepatolenticular Deg) — AR.

- Sunflower C.
  - Cuprous Oxide in Ant lens Capsule & SC. cortex in a stellate pattern
- Kaysner Fleischer Ring
  - Peripheral part of DM in Cornea
  - golden brown ring.

Fabry Disease

Def of Enz α galactosidase

- Systemic
  - CVS.
  - Renal impairment
  - Angiokeratomas.
  - Severe pain in finger & toes.
- Ocular
  - Spoke like lens Opacities Cornea Verticillata.

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Mongolian Idiocy & Hypothyroidism (Cretinism)

Punctate Subcapsular Cataract

Mannosidosis

Def of ∝ Mannosidase

- Systemic
  - Short stature.
  - Skeletal changes
  - HSM
  - MR.
- Ocular
  - Wheel like RSC.

Complicated Cataract

Opacification of lens 2° to some IO disease

x secondary C → as for after Cataract

Etio Nutrition of lens on IO fluids

- Ocular circulation disturbed
- Inflammatory toxins formed

Conditions

Inflammatory Conditions

- Uveal inflammat^n
- Hypopyon.
- C. ulcer
- Endoph
- Fuch's Heterochromic U
  - ↓
  - PSC
- ASC due to post synechiae formation.

Deg Changes

- RP
- R. dystrophy
- Myopic CRD
- Essential Iris atrophy
- Chronic hypotony
- glaucoma.

RD

- IO Tx
  - Rb
  - Melanoma
- Ischaemic Ocular Conditions
  - Takayasu.
  - Buerger

yf → White grey opacities
- Necrotic lens epithelial cells & deg subepithelial cortex.
- >> ASC.

c/f

Ant.

Vacoule below AC

↓

Opacities in neighbouring cortical fibres

↓

Thickening of AC

Post

↓

PSC cataract

Bread Crumb

Polychromatic lustre

↓

Ca^{2+} deposits in later stage.

Drug Induced C

- CS.
- Miotics
- Phenothiazines
- Amiodarone.
- Busulphan — CML
- Gold — RA
- Allopurinol — gout

Corticosteroid Induced → PSC Children >> Adult

↑ dose steroid used to Rx NV.

Patho —
- ↑ glucose
- ↓ Na^+, K^+ ATPase
- ↑ Cation permeability
- ↓ G6PD
- Inhibition of RNA synthesis
- Loss of ATP
- Covalent binding of steroids to lens proteins

C/F
- Subtle iridescent seen in Post Cortical layers
- Granular Opacities
- Plaque like axial opacity of PSC.

Histo → Post migration of lens epithelial cells from lens eq to axis
↓
Aberrant enlargement.

Swollen cells → Wedl, Bladder Cells.

Rx — avoid steroid

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Miotics — Ant subcapsular granular type

Amiodarone induced — ASC stellate shaped axial pigmented opacities deposited in Corneal epithelium
Rare. Optic Neuropathy.

Phenothiazines — Chlorpromazine & thioridazine in Ant capsule in an axial config.

Radiation Cataract

Infrared (Heat)

↓

Acquired PSC

True exfoliation of AC

↓

Outer lamella of lens capsule flake off & tends to scroll on itself

↓

glass blower

glass worker's Cataract

Ionizing Radiation.

↓

Exposure to X rays, γ rays & Neutrons

PCL prone

Radiation → ↑ lens Memb permeability

↓

affect Metab & synthesis of protein & Cell division

- Punctate opacity ⊆ in Post Capsule
- feathery ASC.

UV radiation

↓

Long term exposure.

Electric Cataract → Punctate SC opacities

↓

Linear Opacities in ASC Cater.

Syndermatotic Cataract →

Atopic Dermatitis.

- Ant SC opacities
- Shield like plaques

Rothmund Syndrome.

- Zonular Cataract

Werner's Syndrome.

- formation of PSC.

Displacement of Lens

- Clinico-Etio types
  - Congenital displacement
    - Simple ectopia lentis — AD, Bil, Symm.
    - Ectopia lentis et pupillae — AR, ✓, ✗
    - EL ± systemic Anomalies
      - → Marfan's — SP
      - → Homocystinuria — IN
      - → Weill Marchesani Syndrome
      - → Ehlers Danlos "
      - → Stickler Syndrome
      - → Sulphite Oxidase def.
  - Traumatic displacements
  - Spont.
- Topographical type
  - Subluxation
  - Dislocation.

Subluxation

½ displacement in which lens moves sideways but remain behind pupil.

- ½ rupture
- Unequal stretching of zonules

Cf → Defective vision — Marked Astig, lenticular myopia
Uniocular diplopia
AC — deep & irregular
Iridodonesis
Dark edge of subluxated lens — DDO.

Complication
- Cataractous changes
- Uveitis
- Complete dislocation into AC / pupil
- " " into Viteous

Mx

Non Dx.
- Spectacle & CL correction
- Miotics / Mydriatics
- Laser pupilloplasty

Dx

Ix
- ↓ VA.
- Progressive post subluxat^{n}
- Dislocat^{n} of lens → AC.

Surgical Options →
- Lensectomy
- Ant Vitrectomy
- Phaco
- Intracapsular LE
  - ± scleral fixat^{n} PCIOL
  - ACIOL

Dislocation / Luxation of Lens

Dislocated lens —:

- Incarcerated into pupil
- Present in AC
  " in Vitreous

floating → Lens Nutans

fixed to zonna → Lens fixata.

- +nt in Subzonal space.
  +nt in Subscleral "
- Extende out of globe — 1/2.
  Completely.

CF → Deep AC
Aphakia in pupillary area
Iridodonesis
IOP — lens in Vitreous.

- Deep AC
- +nce of lens in AC
- clear lens looks like an Oil drop in Aq.

Complications → Uveitis
Secondary glaucoma.

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Mx

- Lens in AC & incarcerated in pupil
  - ↓
  - IO Extract^{n} & ACIOL. / Scleral fixated PCIOL
- Lens dislocated post in Viteous
  - ↓
  - Remove & use of PPCL
    - & help of Insulated Viteous Cryoprobe
    - Aspirat^{n} of Viteectomy probe
    - Phaco frag
  - ↓
  - Visual rehab.
    - CL
    - ACIOL
    - Scleral fixated PCIOL.

Pre-Op Cataract Pt

- General Medical Status
- Ocular Evaluation

General Medical Status

- Prce of Systemic dis
  - DM
  - HTN
  - Cardiac Problem
  - COPD
  - H/O. Allergy.
  - Bleeding Disorders
  - Use of Anticoagulants.
- Prce of Musculoskl. disorders
  - Kyphosis
  - Scoliosis
  - Exc obesity
  - Head tremors
  - Nodding
- Potential source of Inf
  - Septic gums
  - UTI

Systemic Implication

Diabetes → PDR, ME Worsens
— Improved visualization of fundus

Recommendation	Anticipated problem
a) Large Capsulorrhexis	Smaller pupil
b) RBS check.	Pigment dispersion.
c) Skip OHA.	Delayed wound healing
d) Light Breakfast.	fibrinous uveitis
e) 1/3 Insulin dose	↑ risk of Endoph.

Hypertension

Anticipation .

Supprachoroidal Hmrg

Recommendations

- BP check
- Should take Anti HTN on day of Sx
- Avoid adrenaline in LA & PE drops
- Sedative a day prior

Carotid Artery Disease

Recommendation →

Sx 3-6 mth after MI

x to stop Oral Anti platelet

Stop Warfarin 3 days prior to Sx

↓

Start injectable heparin.

Use topical Anaesthesia → ↓ bleeding

If Oral Anticoagulant → Sx if PT < 18s.

Continue Routine Medication

x PE

✓ LA without Adrenaline

x Cautery in pt ≤ pacemakers

Provide Stretcher / Wheelchair

Asthmatics

Asthma ↓ control
↓ wheeze
Avoid plastic drapes & special arr of O_2
Avoid NSAIDs
" ACs.
Nebulize Prior.

Renal failure & transplant →
- fitness for Sx
- Avoid Acetazolamide & NSAIDs
- ↓ systemic Aminoglycosides
- Double dosage of steroids

Septic foci — Check dental inf

Ocular Evaluation

H/O. — Exam.

History → Visual Complaints
Pt lifestyle
Past Ocular H/O — Trauma, Amblyopia.
Ix of Sx

↓ Visual Improvement

↓ Medical
Lens Induced ↓
Phacoanaphylactic ↓ Endoph.
RD, ↑ IOP — view
hazed

↓ Cosmetic.
↓
Mature Cataract

Ocular Exam

VA — Unaided → Pinhole
PL
PR
Potential VA tests → LI
PAM.

Pupil — RAPD
Adequate Mydriasis

Ant seg Evaluation

- **Cornea**
  - Scarring
  - Guttae.
  - Specular
- **Signs of Uveitis**
  - KPs
  - Post Synechiae
- **Cataractous lens**
  - Morphology of lens
- **ACD**
  - Iridodonesis
  - Pseudoexfoliat^{n}
  - Shallow AC – OVD
  - Very deep – diffo instrument Manipula

– Pseudoexfoliation — Weak pupillary dilation
Weak zonules — Use CTR.

↓ chance of Nucleus drop.

- IOP measurement

- Lids, Conj, Lacrimal apparatus →
  Local source of Inf
  Conj Swab.
  └ Onew Eyed
  Beyond DCT.
  H/O Chronic Inf — Blepharitis
  Recently healed Corneal Ulcer.

  - Lacr Sac syringing
  - Trichiasis & Entropion.

- Post Seg Evaluation →
  ARMD. see
  If dense Cataract — do Macular fxn test.
  PR.
  2 light discriminat^{n} test
  Maddox Rod test
  Subj. Colour perception
  Entoptic Visualization
  PAM ✓ Hazy media
  LI ✗ ..

  Obj → ERG, VER, Usg B scan.

- Keratometry & Biometry

Pre-Op Preparation

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- Consent
- Hygiene — Clothes, Bath.
  Mark the eye
- Pre-Op Abs & Disinfectants — Topical Abs
  10% Povidone I_2 — To clean
  5% " " → In Conj Sac
- IOP lowering → ECCE & SICS
  Use Honan Ballon.
- Mydriasis — Tropica +
  flus before Sx → To maintain mydriasis

ICCE

Key features Weak & degenerated zonules are pre-requisite

Lens + entire Capsule removed

Ix Markedly subluxated & dislocated lens

CI

x < 40yrs

x

Post op Vitreous related problem +

like Endoph, CME, RD.

»

2° aebesis in DM »

Req of subsequent filtering Sx & keratoplasty

ECCE

Lens + Ant Capsule removed

✓ of choice

Markedly subluxated or dislocated lens

Types

Planned ECCE | SICS | Phaco.

✓ over ← ICCE

Universal procedure

PCIOL implanted

⊖ like Herniation in AC, pupillary block, Vitreous touch Synd

↓ Post op Complicat^{n}

↓ Post op Astig as Smaller Incision

SICS

ECCE ✓ SICS

Simple to master

≤ Short learning curve

(x)

Long incision 8-10mm

Multiple sutures

Open sky procedure

↑ Post op Astig

Post op suture related problems

Need suture removal

SICS Phaco

✓✓

Universal acceptable for all kinds of

Much easier to learn

x Machine dependent

↓ Surg. complications

↓ Operative time (i.e Hard Cataract

Cost effective

x

Corn Congestion

Mild Tenderness

Post op hyphaema.

SIA = 6mm 3-2mm

Manual SICS

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Phaco / /.

✓

Topical Anaesthesia
Post op Corg ↓
small incision
↓ Corneal Comp
» Visual Rehab
↓ Post op Astig

✓

X

» Learning Curve
Unforgiving Complicat^n
Machine dependant
↑ Cost
difficult in hard Cataracts.

ICCE

Pre-Op — Block + Mydriasis + ↓IOP

Surgical steps

- Expose Eye
- Bridle Suture
- ½ limbal groove 150° (9½ – 2½)
- CS Incision ≤ Keratome
- Iridectomy → To prevent Pupil Block by de-Wecker Scissors
- Delivery of Lens
- formation of AC after separating iris & Construct pupil
- PCIOL Implant
- Closure of Incision
- Repposit flap
- SubConj. Dexa
- Patching of Eye.

Delivery of Lens in ICCE

Smith Indian Method

- Tumbling Tech
  - Be at limbus at 6 O clock — Lens expressor
  - 12 O clock — lens spatula
- Lower pole delivered first

Cryoextraction

- Ant surf of lens dried
- -40°C c/t lens & probe
- Zonules ruptured by gentle rotatory movement
- Upper pole first out

Capsule forceps Method

- Jaffe's Capsule holding
- Pc caught at 6 O clock
- Lift the lens
- Rupture the zonules by sideways movement

Erisiphakee Method

Wise Vecti's Method

- Subluxated lens
- Wire vectis below lens.

Planned ECCE

Separation.
- ↓ Ocular Massage
- ↓ Hypotensive use.
- ✓ Pupillary dilation.

Surgical steps

Exposing the eye
↓
Bridle suture passed
↓
fornix based conj flap
↓
Hemostasis
↓
½ thickness groove/gutter → Crescent 120°
↓
CS entry using Keratome
↓
Inj of Visco in AC
↓
Ant Capsulotomy (A)
↓
Removal of AC capsule
↓
Completion of CS section
↓
Hydrodissection
↓
Removal of Nucleus
- Pressure & Counter Pressure method
- Irrigating Wire Vectis Tech

↓
I & A

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Polish

↓

Implantation of IOL

↓

Closure of Incision

↓

Removal of Visco

↓

Close Conj flap

↓

SubConj Dexa

↓

Patching of eye.

(A) Ant Capsulotomy Tech

- Can Opener Tech
  - ↓
  - Irrigating cystotome
    - ↓
    - 360° multiple radial cuts
- Linear Capsulotomy
  - ↓
  - Envelope tech
    - ↓
    - 2-10 O'clock
      - ↓
      - Complete capsulotomy in the end after removal of Nucleus & Cortex
- CCC
  - ↓

Small Incision Cataract Sx

SICS

ECCE

✓
- Simple tech
- Easy learning Curve

✗
- Long incision (10-12mm)
- Multiple sutures
- Open chamber Sx
- ↑ Post op Astig
- Post op suture related
- " " Wound related
- Need suture removal

SICS

✓
- Easy to learn → ✗ CCC must – can use Can opener
  → Hand, foot co-ordination
- Universal applicability → + Trab
  + URSx
  for all kinds of Cataract
- Not machine dependant
- ↓ Surgical complication
- Operating time
- Cost effective
- Conversion during Phaco
- Ideal for mass Sx

Phaco

SICS

✗
- Conj Congestion
- Mild tenderness
- Post op hyphaema
- SIA

Phaco

✓
- Topical Anaesthesia
- Post op congestion
- Small Incision
- ↓ Corneal complicat"
- Visual rehab
- Post op Astig

SICS

Dx

- Mass Dx in high volume
- Non availability of Phaco

C/I Phaco → Ultra Hard Cataract
↓ Endothelial Count

- Bleeding
  - Hyphaema
- Skill & experience of Dx

C/I

- Crystalline lens
  - Sublux
- Corneal Condition
  - Mucocanea
  - Thinning
  - Dystrophy
- Conj conditions
  - Inflamm

Surgical tech of Manual SICS

1) 2R bridle sutures — 10mm away 3-0 silk 1/2 curved cutting needle

- fixation of globe in downward gaze.
- counter traction during Nucleus expression

2) Conj flap, Exposure of sclera & haemostasis

Seperate Conj flap → tenon → Hemostasis achieved

3) Sclerocaneal tunnel

↓

Make side port

- CCC
- If hypotonous eye inject Visco
- Aspiration of Subincisional Cortex
- reformation of AC.

↓

Fixing ACM

4) Anterior Capsulorhexis

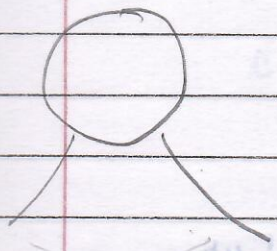
- Emptumentation
- Dyes
- Tech.

Sclerocorneal Tunnel Incision

Kratz
Girard & Hoffman — ~~2 plane~~ Post incision — Scleral T
Mc Farland → 2 plane
Paul Ernest — 3 plane

Koch's ~~Astigmatism~~ funnel
Incisional

Incisional funnel



Diag

- from limbus
-) Induced Astig
-) Incisional Length.
-) Distance of incision from limbus

funnel — Imaginary area — Astig neutral incision

Short/close ⟺ Long/farther.

Astig ∝ scleral incision length ∝ 1

dist of incision from limbus

Architecture

- External Scleral incision
- Sclerocorneal tunnel
- Internal Corneal Incision

External scleral incision → 1.5 - 2mm behind
5.5 - 7.5mm long ∝ hardness

Config

- Straight
  - ⊗ > 2mm → Astig
  - » Post then — Manoeuvring of instrument difficult
- Seaon.
  - Anti Smile
  - Ends away from cornea
  - > Stable
  - ↓ Astigmatism
  - Best
- Chevron
  - Reverse V
  - Split
  - ⟺ Seaon
- Trapezoid
  - Bigger Nucleus

2) Sclero-Corneal tunnel 2·8mm Crescent

Extend 1-1.5mm ant into clear Cornea

↓

Depth

↓

Superficial	Not deep	Optimum
↓	↓	↓
Blade clearly visible	Barely visible	Just visible
↓	↓	
Buttonholing	Pre-mature entry	

→ Cornea » curved ∴ turn heel up.

↓

Make scleral if Larger Nucleus pockets

↓

⊙ Make side port.

↓

⊙ Fix ACM → Must in Blumenthal tech of Nucleus Mx 1.5mm long entry at 6 Oclock

ACM – 0.9mm outer & 0.65mm interior dia
enter bevel up & fix bevel down (facing iris)
enter 4m temporal side
50-60cm Ht of bottle

3) Internal Corneal Incision → Cut while moving x to cut AM.
2·8mm L Keratome

Anterior Capsulotomy

Cystitome
↓
26 G needle
110°
2 L → 2 mm from hub 100°

Capsulorrhexis forceps. (Utrata forceps)
Mc pherson can be used.

Inject air bubble
↓
Inject dye underneath to prevent C. endothelium from staining.

Tech

- Can Opener Capsulotomy
  - ✓ Beginners
  - ✓ Convert to it difficult situat^{n}
    - Mature C
    - Narrow pupil
    - Calcified fibrosed capsule
    - glide IV NS
  - 6.5 mm to avoid zonular damage
  - Radial Cuts
  - Postage Stamp
  - (X) — txt of Cut Damage to Zonule
- Linear (Envelope)
  - ✓ Hypermature C
  - ✓ Fish Hook tech
  - Cystitome
  - ↓
  - 10L imp
  - ↓
  - Cut end ⊆ Vannas
  - ↓
  - Tear ⊆ Capsulorrhexis forceps
- Christmas tree
  - (X) Damage to Zonule
  - Radial ext
  - △
- CCC.
  - → Cystitom
  - → Forceps
  - → Both

Continous Curvilinear Capsulorrhexis

Gimble & Neuhann

Pre-Req → good akinesia
good pre-op hypotony
good red reflex

6-6.5mm tear.

Cystitome
side port or
Main port

Forceps

Utrata.
- grip is good
- Easier to change direct"
» fibrotic
Atrophic
Elastic
» Paediatric
Morgagnian &
Intumescent C.

Shearing force
↓
Centripetal force
2-3 clock hr step
flat & intact Capsule tip

Ripping force
⊥ to direction of tear

↓
Also for doing Post Capsulorrhexis

(X) » Wound leak &
corneal distortion
difficult to use in ↓
viscosity substance

Inject- visco flatten
5-10 strokes

✓ safer
- Vector force & direction as tearing better Control

> extension chances

Hydroprocedures

Hydrodissection

Term by Faust

4m Capsule

Seperation of Cortico Nuclear mass from Capsule ⊆ help of Mech fluid wave.

↓

✓ rotation, hydrate peripheral cortex, making it easier to aspirate

↓

Do CCC

↓

~~Post~~ Visco → BSS

↓

Imp to prevent PCR

→ & Nucleus deep

→ Always from Main port (*)

↓

2cc Syringe. tip 1mm beneath Capsule & Capsule is lifted.

↓

× seen in Mature Cataract

Travel in Waves

SICS . Phaco .

Hydrodelineation

Ans

Seperation of Outer Epinuclear shell as multiple shells 4m central compact mass the endonucleus by forceful injection of BSS into Subst of Nucleus

SICS

↓

✓ Only if

→ incision < 5 mm

→ Or Nucleus hasto be divided

× used in White C.

In Immature → golden Ring Epinucleus 4m Endo

Contdd

ICCE

↓

Prolapse of Nucleus out of Capsular Bag

↓

Press down while Inj

↓

Mech & Hydrostatic force. Opp pole to pope out

↓

Dial the Nucleus.

Let Nucleus Come Out

Phaco.

↓

lens bulges — drop Injecting

↓

Decompress. Bag by gently depressing central portion

↓

different directions

↓

till Connections are broken & Mass can be rotated.

Nucleus Management

- Prolapse of Nucleus out of Capsular Bag into AC
  - Hydroprolapsing method
    - occurs if + pressure over nucleus
  - ± Sinskey hook
    - Size of Nucleus >6 mm
      - Small zonulysis
        - ↓ give relaxing incision
        - ↓ Engage upper pole & dial out
        - ↓ Cautioned it
        - ↓ Be gentle else zonular dehiscence
- Delivery of Nucleus outside eye thr CS tunnel

Nucleus Extraction → Phacosection.

- Irrigating Hise Vectis
- Blumenthal tech
- Phacosandwitch tech
- Fish hook tech

Nucleus extraction ⊆ an irrigating wire

Vectis Method

4mm width 9mm length

Ant surf → Concave & has got serrations → grip to lens → 3 opening of 0.3mm each

Post surf → Smooth & Convex

a) Inject OVD in the AC

b) Insertion of Vectis in AC — By holding SR suture insinuate vectis behind nucleus

pull SR — withdraw irrigating vectis till superior of nucleus is engaged in the tunnel

Now start irrigating & press down scleral lip

↓ force of irrigation once maximum diameter is out

To prevent sudden decompression

Inject OVD. into AC.

Adv.

Only single instrument

AC remains formed throughout

Delivery is fast & Easy

Burnt taken by wall of tunnel so endothelium is spared

✓ in cases of premature entry in AC & superior limbal dehiscence.

Disadv.

Iris trauma may occur

PCR with Viteous loss may occur

Corneal damage may ✓ due to faulty tech.

Blumenthal Mini Nucleus Tech

2nd most popular

↓

Nucleus delivered ⊆ hydropressure t/c/as hydroexpression of nucleus. Based on Anatomy of lens

↓

Soft superficial Cortex.	Intermediate epinucleus	Hardcore Endonucleus
↓	↓	↓
Easily aspirated	Expressed or Aspirated	Expressed or #
		↓
		Mini Nucleus Tech.

Steps — ACM system in situ

↓

After prolapse of Nucleus

Plastic lens glide	Iris separator
3-4mm wide	
0.3mm thick.	
3cm long.	

↓

Inserted at 12 O clock

↓

Switch on ACM ⊆ Bottle Ht 50-60 cm

↓

tap on lens glide — deluse Nucleus

If difficult

↓

Modified Tech

↑ Bottle height

23 guage needle

Clip the nucleus

↓

After delivery of Nucleus

↓

Remove ACM

fish hook Technique

Henning tech or Lahan Tech

CCC or Envelope tech

30G need ½" needle bend

Lower part of Capsule & PC

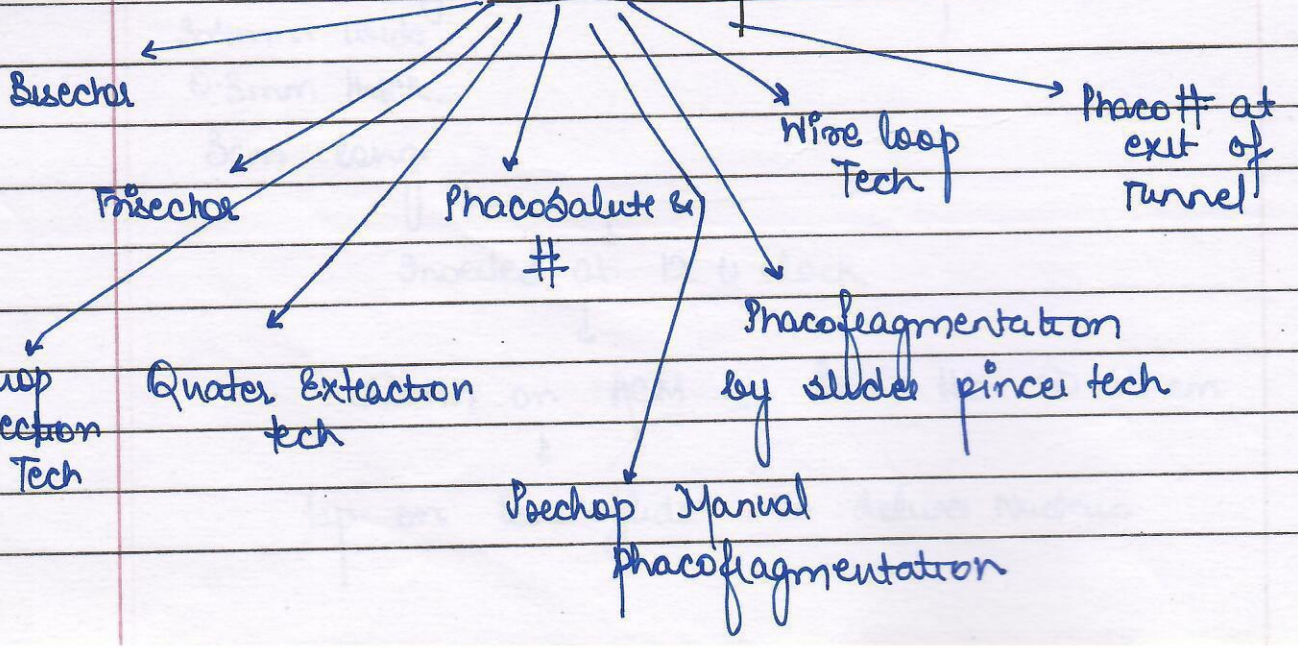
Prolapse sup pole in AC

Phacosandwitch Tech

Irrigating vectis below & dialer above

Pull SR bridle sutures

Phacosection / Phaco # Tech



Busector Tech

Hise Vectis & Nucleome Irrigating Vectis & Sinskey hook.

Trisector Tech

3 ½

Phacosalute & #

Make Nucleus Vertical in AC & Cut.

Phaco # with wire loop.

Chip the nucleus when delivering out of tunnel

Phaco frag by slider pincer tech

Slider pincer instrument

Nucleus positioned b/t

Quater Extract^{n} Tech

Chip front Quat using Nucleus pincher

Extracted using Akrea's irrigating claw Vectis.

Chop Section tech.

Spatula → Bonnaque

Chopper → Nagahara.

Cut & extract by any tech

Bechop Manual frag.

Bechopper forceps

3.2mm temporal Incision (Main port

Aspiration of Cortex

Remaining debris, Epinucleus, cortex & Visco-elastic material

Pre-Requisite for good clean up → CCC
Hydro-dissection
good Quality Sincoe

Golden Rules → Never aspirate blindly
Discourage in periphery
If PC. ruptures → Sphere formation.

Spl Situations → Tackle intact epiNucleus
Manag^n 12 O clock Cortex.
Cortex aspiration in small pupil
Mx Cortex in PCR.

(a) Tackle intact Nucleus

✓ OCM ✗

(Blumenthal Tech)

↓

↑ pressure & press Scleral lip

a) Flipping Tech → Canula under AC rim of nucleus into AC

↓

Do polish if req.

b) Visco-dissection tech

Mx of 12 O clock Cortex

Difficult due to long tunnel Capsulorrhexis

↓

Perform hydrodissection at 12 O clock

- J shaped Canula
- Side port entry at 9-10 O clock
- Bimanual
- Displacing the Cortex by dialling the IOL

In small pupil

- Bimanual
- Side port

PCR

- Dry Aspiration
  - Put Cohesive
  - ↓
  - Peel from Eq towards centre
  - ↓
  - ~~Forceps~~ c/c out Aspiration.
- Ant Vitrectomy
  - ↓
  - Vitreous dist +
  - ↓
  - Do Vitrectomy
  - ↓
  - Put Iridectomy

IOL implantation

choice

- PMMA IOL.
  - 6mm Optic size.
- Phaco profile PMMA IOL
  - 5-5.25mm. Size
  - Phaco # tech
- foldable IOL.
  - < 5mm
  - Phacofrag tech
    - Square edge as ↓ PCO chances

Tech

- PCIOL
  - Mcpherson
    - Scaling Tech.
    - Looping tech
      - fold the inferior haptic
- Ciliary Sulcus
  - Big PCR.
  - Cant Opercs.
  - Small AC flaps left
  - 2° IOL with obliterated Capsular fornices
- Scleral fixated

↓

Removal of Visco-elastic

- else 2° glaucoma
- Vocal inflammation

Wound Closure

↓

Sutures

−

less

+

Why

large tunnel >6-5mm to avoid ATR

- Leaking tunnel
- Premature entry in AC
- Paediatric (Thin Sclera)
- Combined SICS + Trab.

Tech

Vertical

a) Radial
b) Cross Sutures

Horizontal

Shepherd's Single Sutures.

Fine's Infinity Sutures

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a) Mention of Complications

b) Astigmatic Control

Phaco. H/O

1948 — Kelman — dentist — USG use

1mm. hollow titanium.

US speed 40,000 times/s. piezoelectric eff.

? Reluctance	? Acceptance
1) High risk of complication - PCR - Endothelial damage.	→ OVD Healon → Foldable IOL Mazzocco 1980.
2) Necessity to enlarge incision to implant IOL.	→ CCC — Neuhmann 1986 → Refinement in Phaco machine.

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Academics

Kelman 1967 (Mark I)

- Console
- Hand Piece.
- foot pedal & their Connections

Console

- Phaco power
- Irrigation Aspiration

Handpiece

- Phaco
- Irrigation Aspiration

Phaco Handpiece

Ultrasonic handpiece

Tip

- delivery of power → Piezoelectric effect
- Irrigation
- Aspiration & Control System.

Phaco Tip → 27,000 Hz to 60,000 Hz.

Silicon sleeve → 180° apart Irrigation.

Irr → Cools handpiece
Keep AC formed.

Phaco Tip types

- Standard
  - Cobra tip.
  - Kelman (Bent) Tip.
- MicroTip
- ABS tip
- Flared tips
- Mackool tips

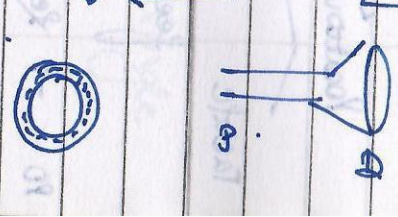
- Nucleoflow
- Diaphragm
- Turbosonic.

a) Std Phaco tip → Straight shaft 19g bore needle
Outer dia = 1.1mm
Inner = 0.9mm

Name	Diag	Cutting	Holding	Use
0				Chop tech.
15				Improving flowability
30°		⇔		Beginners
45°				Sculpting
60°				(X) used

b) ~~Kelman (Bent tip)~~
Cobra tip
↑ width distal part
tedency to heat up.

Characteristic	Kelman	Nucleotip	Mackool	Flared	ABS	Nucleflow	Diaphragm	Ultrasonic
Spl features	a) Adds NOx axial vibrat^n to 1° long radial vibrat^n b) Non axial + axial vibrat^n ↓ ↑ Mech break down	21G OD = 0.8mm ID = 0.6mm	Thin polyamide insulation tubing	Nucleo + Std. P 0.6 → Nucleo D 0.9 → Std	Small hole in distal end of phaco tip ↓ Hole provide ↓ Continuous flow thru. Nucleus even during occlu.	Ext long grooves ↓ ID → provide continuous cooling irrig fluid even when Si. Sleeve is compressed against Needle by incisional pressure	Construction of internal lumen at distal end ↓ surge. ✓ used in Vacuum settings	20,000 Hz tip design - Dynamically balanced - tapered sub.
Adv.	a) ↑ total cavitat^n at tip ≅ same out of power b) → ∴ used for cutting Hard Nu c) » Ergonomic lesser stress on wound	Smaller incision ↑ visibility ↑ Manouvd Precise cutting Enhanced surge protect^n bcos of ↓ lumen	↓ transmiss^n ↓ thermal burn	Better hold^n P when occluded → P → fluidics better ↑ Vaccum level D → » vol of Nucleus material can be engaged	• Cools down • ↓ chances of surge	⇒ Smaller dia → fluidic benefit in surge		
Disadv.								



Mac Std flared tip.

Irrigation System

- Co-axial I/A
- Bimanual I&A

Co-axial I/A →

Aspirat^{n} port on side

0.2 - 0.7mm (>0.3mm)

- Better Vaccum seal
- ↑ Aspiration time

Foot Pedal

- Positions
  - Tactile
  - Audutory feedback
- Side kick Move^{n}
- Other fxn.

P0 → Resting position x fxn

P1 – Irri – x gradient +

P2 → I/A – α gradient till full aspiration

P3 – IAP – excursion after 2nd deviation

Foot gradient = 1mm = 1 unit

a) foot pedal Reflux Control

b) CIM – Eye remains pressurized → Beginners.

- Pulse On-off fxn
- Bottle Ht. Adj
- Multimode panel
- Dual linear Mode ↔ ↕ B&L.

Phacodynamics

Phaco power ⇌ Irriga tion Aspi
"Interrelat"

Study of main fxn of phaco machine which include phaco power delivery & irrig aspi & its inter relationship.

- Fluidics
- Phaco power Modulation
- Surge & its prevention

Fluidics

Refers to Irri Aspi system & its parameters on which it depends

- Irrigation
- Aspiration

Irrigation (Infusion) System → Co-axially or Single handpiece
Occurs thru irrigating Si sleeve.
delivers 80-85 cc of fluid/min

- Conventional Phaco
  - ↳ ↑ Ht of bottle
  - ↳ gravity fed = 3 ft = 90 cm ± 1 ft. = 110 ± 10
- Micro-phaco.

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Micro Phaco → 40-45cc fluid delivered
↑ irrigat^n thro irrigation chopper

Methods a) ↑ Bottle Ht → ↑ by 12 inches ∴ ↑ Pse by ↑ atm pressure

b) Use of atm pressure pump → fish pond pump
infuse. air into BSS bottle
↓
fluid gush out
↓
Prevent surge

(X) → inability to control IOP

c) Use of ACM → thro extra port ↑ fluid in AC without ↑IOP.
Can do CCC ± out Visco.

d) Use of Pressurized bottle – inject 50cc air & take out Needle
80-85 cc
Now for cortex removal ↓ flow req
insert 20G airway needle.
∴ gravity fed procedure

e) Mechanized Pressure infusion → Combined A+P machine

Accurus → Alcon
Millennium → B&L.

7) Pressurized plastic bottle using BP cuff

Aspiration Systems

fxn →

- Lavage of AC
  - ↓
  - ∝ flow Rate
- Creation of hold for emulsification
  - ∝ Vaccum generated.

a) Aspiration flow Rates → removed from eye → Vol of fluid in ml/min

Peristaltic System → ∝ Speed of pump
∝ Compliance
Venting
Tubing

To ↑ AFR → higher bottle
→ ∴ swift removal of lens matter ⇒ ↓ powers.

↓ AFR → when working near Capsule

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Vaccum

Amt of neg pressure created in the tubing

V. created during occlusion

Rise Time → Time taken from occlusion of phaco tip to reach max preset vaccum.

- Venturi
  - fast linear
  - ∝ highest preset V.
- P
  - bt x linear
  - ∝ AFR setting
  - ∝ Pump speed

$\propto \frac{1}{\text{Bore size of Phaco tip.}}$

Occlusion → obstruction of aspiration port

$V \propto \frac{1}{\text{Pressure req to remove the lens.}}$

Zone of Aspiration

- OSL.
  - ∈ in Capsulorrhexis margin
    - ↓ Hypermetrope
    - ↑ Myopic
      - Zonular stress Synds
      - Vitrectomized eye
- PUSL.
  - ↓ Capsular fornices
  - Region of ∠D of AC
    - ↓ dangerous here.

Flowability

Ability of fluidic system to attract & hold Nuclear or Cortical material on distal end of US/IA piece until material evacuated by Vacuum forces

- Created by pressure gradient of top
  - +ve
    - ↓ Infusion
    - ↓ Bottle Ht
  - -ve
    - ↓ Vacuum
    - ↓ Aspiration pump
      - V > P ∴
      - » flowability
- > Smaller pieces of Nucleus
  - ↓
  - » Smaller pieces ∴ imp of Mech crushing of pieces
- Zones of flowability.
  - ↓ 3 zones

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Zones of flowability

Good
↓
around Phaco tip

Poor
< of AC
Capsular fornices
Can be ↑ by
↓
hold Nucleus &
get to Centre
before aspiration

No
↓
Spont leak of fluid
- Main W
- Side port
- Dome of Corneal

↓
Mech fragments are brought.

Types of Aspiration System

- Flow Pumps
  - Peristaltic
  - Scroll
- Vacuum Pumps
  - Venturi
  - Diaphragm
  - Rotatory Vane P.

Flow Pumps

Peristaltic

- Heart lung Machine

Pump rotates
↓
Roller engage asp Tubing & collapse at Contact ⊆ Roller
↓
∴ Boluses propagated

Speed ∝ fluid withdrawn

AFR ↑ → Vaccum created ⊆ out. Occlusion of port

(✓)
- Slow Vacuum build up
- Lag has to be app to build V
- ↑ Safety margin ∴ user friendly
- AFR & Vacuum Can be changed

AFR — Commanded Vacuum ∝ Occlusion tip

(✗)
Potential surge problem → Pump leakage

Scroll

Pump housing
Rigid Scroll elements
↓
Can Use ↓ Compliant tubing ∴
- ↓ Surge
- ↓ Leak → Can be used in V. emulation mode

Recent Advances

- Use of Bio Compliant tubing
- .. .. Sealed Rigid Cassette
- Software control Algos → To compen leakage.

Vaccum Pump

Salient features →

a) Vaccum level → Instantaneously achieve.
Surgeon commands actual V. level

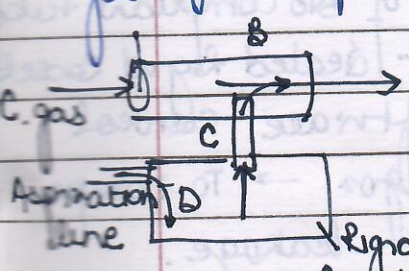
b) Aff → is controlled & not commanded. ∴
governed by Level of Reset Vacuum
Aspiration Port Size
Degree of Occlusion of Asp port
Viscosity of Asp fluid

c) V. pump ∝ ⊥ linked to fluid in Aspiration line
via air in drainage cassette

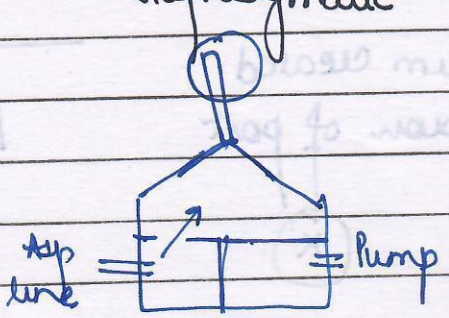
d) Cassette in Vaccum vs pouch in flow pump
e) good flowability
f) ↑ risk of post- capsular rupture

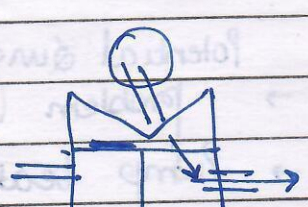
Types

Venturi
M.C used
driven by compressed gas



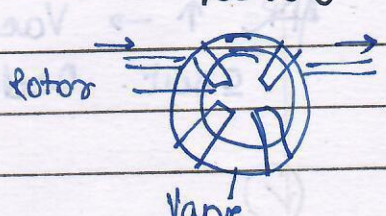
Diaphragmatic





fast Aff.
Rapid rise in Vaccum

Rotatory Vane



Vaccum ∝ Pump motor speed

Venturi	System	Peristaltic
~~Venturi~~ fast, Linear		
∝ highest preset Vac	Rise Time	∝ AFR, ∝ pump speed
More efficient	Neg. Pressure	
Cassette.	Mode.	Pouch
good.	Flowability	
fast	Vaccum build up	slow
flow rates.	Indirectly controlled	Vaccum
It pulls itself	Nuclear fragments	Need to be approached
↓	Safety Margin	↑
x	Beginners	✓
	AFR/Vaccum Setting	Independently
↓ as small TOS	Surge Problem	>>
	Pump leakage (Vol. efficiency)	>> Poor.
Rigid.	Drainage pouch	flexible.

Mech of action of Phaco Power.

- Direct Impact
  - Jackhammer effect
    - ∝ stroke length
    - freq of Vibration
    - ↑ freq = Cut smoothly & ↓ repulsion
    - ∴ Nucleus need to be fixed — during trench"
  - Chatter #
    - repulsion of Nuclear fragments 4m Ultrasonic typ. occuring as a result of Jackhammer effect
    - ↓ by ↓ power ⇒ ↓ stroke length
- Cavitation effect
  - refers to gas bubble 4m fluid in response to pressure changes at phaco tip
  - Cavitat" bubble
  - Intense heat & PE
  - CE ∝ 1/freq.
- Acoustic Wave effect
  - Sonic Wave Prop
  - Acoustic breakdo of lenticular material
  - Push lenticular preces away if hold is not good
  - ∴ ↓ Jackhammer effect.

Sweet spot — Exact spot at foot pedal at which nucleus prede gets attracted to tip & get emulsified.

Modes of Phaco power

- Continous
- Pulse
- Burst.
- Hypepulse

Phaco power = Grade of Nucleus x 15 + 25

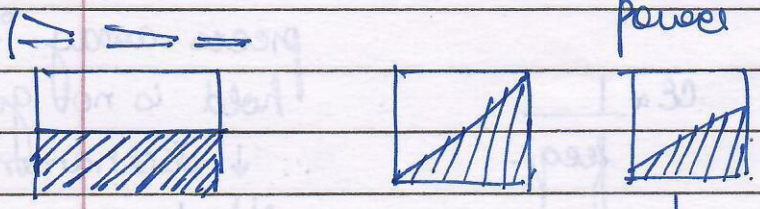
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Continous.

Constant delivery of power in position 3.

Control by

- Panel → Panel Control Mode → × Variation
- Surgeon → Surgeon Control Mode → Variable & Preset power



Use

Very hard Cataract
- Uniformly ↑ed
- Uniform ↑ power

∝ density of N.

✓ ⇒ Sculpting deep grooves in lens Nucleus
Divide & Conquer.
Chop & Chop.

✗ Prefeed

Pulse.

Pulse per sec (pps)

On & off

Linear power delivery but at fixed interval

0-12 pulse mainly

1/2 the CM.



Duty cycle = $\frac{On}{On + off}$

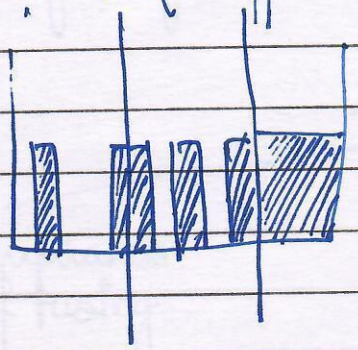
- Power ↓ to 50%.
- Stable AC maintained
- Firmer grasp of lens material
- ↓ chatter at tip bcos vacuum build o/t each pulse
- Allows > flowability & swifter emulsification

Burst

3rd gen Machine

Preset power delivery at interval ↓ as foot pedal is depressed

↓ 50% (as off time is ≫)



Hypepulse.

linear Control of power

off > on

Duty cycle < 50%.

100 PPS ≤ adjustable pulse duration as short as 5 msec

Cold Phaco [Hypepulse — Alcon Infinity
Whitestar — AMO Sovereign



✓

Hard, Brunescent Cataract
Making Vertical chop
Impaling Nucleus fragment

USG used ↓ than pulse

off > on

✓

- USG delivered is ↓
- Thermal heat is ↓

↓ Corneal Wound as ≫ off times

∴ K/C as Cold Phaco

↑ Flowability
↓ Chatter ∴ smoother emulsification

Surge

def Phenomenon that occurs due to extra fluid asp when occluded phaco tip with built up vacuum is suddenly disoccluded

⇒ Result 4m ↑AC pres ⟶ ↓ Press in front of Phaco tip

Neg Surge ↑ ⟶ AC collapse ✓
damage to Iris, Cornea & Capsular rupture.

Factors Contributing

- Compliance of tubing
- Peristaltic / Venturi
- Vacuum & AFR.

a) Compliance of Tubing → Property of tubing to collapse (deform under pressure)

Occlusion → Vacuum ↑ → Rollers stop → Neg Pressure created → Tubing collapse

goes → Tubing expand
∴ Extra fluid 4m AC goes inside
⇓
Surge.

b) Peristaltic **vs** Venturi

Independently control Vacuum & AFR.
↓ Surge risk
bt offset by » Compliant tubing

Venturi
×
↑
Practically ↓ risk

2. 3. Controlled by foot pedal

Vaccum & Aspiration flow Rates →

High Vaccum level
- » collapse of tubing on Occlusion
- » Surge when O. broken.

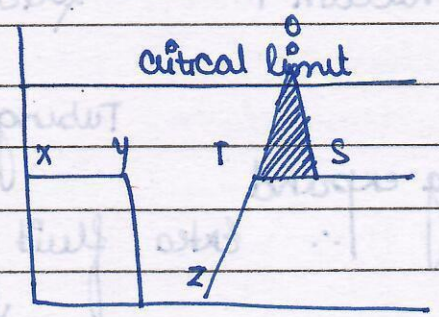
High Aspiration flow Rate
- > Critical limit is associated ⊆ ∴ ↑ risk of Surge.

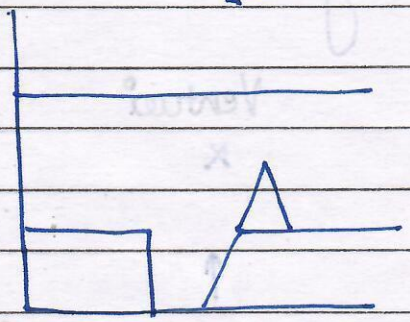
Critical limit
- Upper limit of AFR.
- AC stable for fixed bottle Ht & fluid Leakage

AFR + Wound leak = Infusion

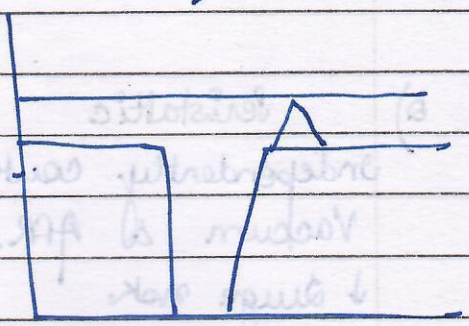
AFR > Critical
- AC Unstable

<
- » Safety margin





Vaccum same. flow Rate ↓



↓ Vacuum Asp/flow Rate same

↓ AFR

↓ Surge

Procedure slow

∴ do it when holding power req.

- Chopping
- PhacoAsp of hard Cataract

↓ Vaccum

hold x req.

Eg. Divide & Conquer.
- Soft Cataract.
- Removal of Epinuclear plate

Control of Surge

Changes in Machine

Surgeon's Measures.

(a) Improvisation in phaco machine to control surge →

Efforts to ↓ Compliance in peristaltic pump

- Use of Bio compliant tubing
- Use of sealed rigid cassettes
- Use of software control algorithms

↑ Outflow.

Use of pressure transducer & log control of pump

- Venting
- Smaller dia tubing & phaco tip.
- ABS tip
- Cruise Control

a) Use of BioCompliant tubing — Hybrid use

» Compliant
↓
At pt of pump rollers

↓ Compliant
↓
» length b/t pump & handpiece

(b) Use of sealed rigid Casettes
↓
~~Over tubing~~ over rollers

Pump head rollers
↓
Alcon infinity
↓
↓ Compliance
↑ responsiveness.

Tubing

(c) Use of software Control Algorhythms to compensate for Leakage
↓
↑ Volumetric efficiency
∝ Surgeon Preference

(2) Efforts to ↑ Inflow

↑ Infusion phaco sleeve
↓
» Inflow potential

2nd Irrigation bottle
↓
Surgical design machine to Control Surge

(3) Use of Pressure transducers & Log Controlled pump
↓
delay in start of pump before & after occlusion

(4) Venting → Neutralizing aspirat" Vaccum line b/t pump & occlusion at tip.

After occlusion break → Vent valve opens & volume of re-expanding collapsed tubing is filled

Air Venting → since air is Compressible remain in System
↑ Compliance of tubing
↑ Surge

fluid Venting → better

(5) Smaller dia tubings & phaco tips
0.6mm
0.9mm.
Flared phaco tips
Micro flow
↓
Restricts flow
Prevents Surge

(6) ABS tip (Alcon) →

(7) Cruise Control → att b/t phaco handpiece & aspiration tubing

Conventional — Micro Incision phaco.

↓

flow restrictor of 0.3 mm ID placed behind mesh filter that traps all emulsified Nucleus

↓

∴ prevent Narrow lumen getting clogged.

(8) differential AFR & Vacuum settings before & after occlusion

↓

As Occlusion breaks AFR, Vacuum ↓ for short period to prevent surge.

Surgeon's Measure

- Choice of hardware before starting Sx
  - More restrictive phaco needle
  - More restrictive tubing set
  - Inflow can be augmented
    - ACM
    - Alcon ↑ infusion sleeves
- Proper Wound Construction 2.8–3 mm
  - Too Tight → Long tunnel → ↓ Inflow → I ≠ 0 ∴ Surge
  - Too leaky
- Manipulation of bottle Ht, setting for AFR, Vacuum
  - ↑ Bottle Ht
  - ↓ Vacuum
  - ↓ AFR

- ½ Occlusion of tip.
  - ≤ another nuclear fragment before occlusion breaks
- good foot control.
  - ↓
  - Lift the foot before Occlusion breaks
- Use of Visco-elastic Substance
  - ↓
  - ↓ Surge by ↓ effective flow rate

Salient features of -

Alcon infinity

a) Neosonix tech - rotational oscillations

b) Ogil torsional tech

- Rotatory → 32kHz
- Long → 44kHz.

c) More efficient use of power
   - ↓ Energy
   - ↓ Heat

B&L Millennium

- Unique foot pedal
- ↑ Vaccum & aut commensurate phaco power
- Custom Control software 5 modes
- Multiple burst setting

Sonic Wave Phaco (Staar Sx)

- Sonic Wave technology
  - ↓ Δ
  - ↓ Cavitation effect
- High Vaccum
- Auto Correlation Mode
- Surge Control
- Cruise Control chamber

Sovereign (Allergan)

- Whitestar ICE (↑ Control & efficiency)
- Digital ultrapulsing of USG energy
- Whitestar CASE (Chamber Stabilization Environment)
- ↓ reduction in heat.

Phaco

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Cleaning, draping
↓
Side port Incision
↓
Phaco Wound Construction
↓
Capsulorrhexis
↓
Hydroprocedures
↓
Nucleotomy & PhacoAsp
↓
Epinuclear plate Removal
↓
Cortical Aspiration
↓
IOL Implantation

Side port incision →

(a) Purpose →
- Injection of Visco → AC maintain
- CCC formation
- Introduction of Chopper / Sinskey Hook
- Stabilization of globe during Sx
- Introduction of 2nd instrument → To protect PCR
- Irrigation & Aspiration of Cortical matter.

Location

- For divide & Conquer & Central chop → 3 O'clock away 4m main incision
- Peripheral chop → 2 clock Hr away
- 2 port → preferably 180° apart

Adv of 2 side ports

- Good AC stability → few Capsular fold → ↓ risk of tear
- Easier to grasp Cortical matter
- ↓ risk of iris touch
- Ability to crush epinucleus & Small Nuclear fragments
- Capsular polishing

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Size of side port

1–1.5 mm

- Optimal → free instrument ↓ leak
- Tight → difficult instrument entry → C. Edema
- large tunnel → Iris prolapse → Unstable AC

Tech

15° | MVR blade

clear cornea

// to iris surface

Timing & Surgeon to Dx.

Phaco Wound Construction

- Sclerocorneal
- Limbal-Corneal
- Clear Corneal tunnel
  - Triplanar
  - Modified triplanar
  - Biplanar
  - Uniplanar

Sclero-Corneal

New foldable IOL
3-3.5mm width
1.5mm sclera — 1.5-2 Cornea

↓
Enlarge to 5.5mm length before IOL Implantation

✓
↓ Astigmatism
↓ chances of Infection as Wound being covered by Conj
Early healing & stabilizat^n of W due to Vascular scleral part of I

✗
x under Topical
Longer time > precision
Troublesome bleed
difficult instrument Manipulat^n
Iris prolapse

Limbal-Corneal

↳ Ext Vertical groove
3.2m long.
0.5 mm behind edge
↳ Limbal Corneal tunnel
2-2.5mm dissected ⊆ help of crescent blade
↳ Internal Corneal Incision help of 2.8mm Keratome

✓
- ↓ Astig
- Early healing
- Wider tunnel & Value than CCC

✗
- Ballooning in Conj.
- Bleeding in AC.

Clear Corneal Incision

» foldable IOL

✓ → × Need of Conj flap
× Bleed
↓ IA
Easy Instrument Manipulation
No distortion of Cornea.

Uniplanar. Biplanar Triplanar Modified triplanar.

Superior Temporal

✓

- Surgeon hand on forehead
- Incision below UL.. ↓ discomfort

↓ SIA
good Sx access
No problem of Bell's
Bleb site ✓
- Natural drainage of irrigating fluid
→ ↓ chances of locking Instruments
better Red reflex

✗

- Orbital edge impairs access » Pt deep set eyes
- > SIA.

- side change
- > head turn
- > Nasal turn
- > theoretical chances of infection

	Uniplanar	Biplanar	Triplanar	Modified Triplanar
Tech.	x by Beginners Stab incision 1.75mm - 2mm Internal & // to Ext Corneal Incision	Ext groove 1.75mm ↓ Internal Corneal incision 2.8 - 3.2mm Keratome	• Ext Vertical groove 500µ 3-3.5mm with blade • Corneal tunnel 1.75mm Straight & // • Internal Corneal incision ↓ Pause heel & advance	Vertical Stab ⊥ to Cornea ↓ Corneal tunnel 1.75mm width ↓ Internal Corneal incision
Adv		= Triplanar x Crescent reg.	- Well Controlled - Excellent self sealing	
Disadv	Astigmatism Control	Premature entry > chances » four edges	> time > instruments	

Value Action →

CCC

✓ → Ensure safe EndoCapsular Sx
hydro-dissection
Permits PCIOL in event of PCR or Vitreous loss
Allow Quick removal of Cortical lens matter as there are no flaps
Help to Centralize IOL properly
Eliminate UGH problem.

Size 5-6 mm
Shd cover IOL 0.25mm circumferentially
Larger Nexus in harder Cataracts.

Hydroprocedure

As in SICS.
Nuclear Rotation

Tech
- One hand
- 2 hand

Difficult when → Soft Nucleus
Inadequate hydrodissection
Loose Zonules

Note
No forcible action.

Special Case
Hard Cataract
Pseudoexfoliation
Difficult Rotation

Nucleotomy

Terms

- Sculpting
  - Trench
  - Crater formation
- Nucleofractis
  - Cleaving the Nucleus
- PhaCo Chop
  - Splitting Nucleus into pieces.

Evolution of Tech of Nucleotomy

- AC
  - Chestnut tree
  - Single handed
  - C. Endothelium (X)
- Pupillary plane
  - Lft Endo & PC
  - 2 hand
  - (little tch) Cyclodialysis spatula seperate Eg.
- SupraCapsular
  - Prolapse of Nucleus & deposit on Nucleus
- Post Chamber
  - Malaney's Tech.
- EndoCapsular ↑

EndoCapsular Phaco

Based on innovations — Self sealing Corneal Incision.
Capsulorhexis
Hydrodissection
Implantation of foldable IOLs.

EndoCapsular Tech

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- Without Nucleo#
  - 1 hand (Shepherd)
  - Inter Capsular (Muchelsiai & Kaia)
  - 2 hand (Cut & Suck)
  - Chip & flip
- ± Mixed fracture
  - Divide & Conquer
    - Trench :: Conquer
      - Soft
      - Hard
    - Crater :: Conquer.
      - Moderate
      - Very hard
    - Trench :: Conquer ± down slope sculpting
  - Shepherd in situ
  - Crack & flip
  - Malorey & Dilman's fractional 2:4 phaco.
- With pure Nucleo#
  - Phaco Chop
  - Lens Quake
  - Fre Chopping

Deep Maltese cross trenching

Splitting of Nucleus

Phaco of Nuclear #

Trench Divide & Conquer

Trench

Vaccum = 25 ± 5
Power = 40 +10 +10
Asp = 25
(25+25+40)

Dimensions

Length 4-5mm
Width 2 tip.
Depth: Red glow visible

Start at Centre
↓
keep using Visco
↓
30° u/s tip
↓
Foot 3 to 1
↓
End pt is
Red glow

Divide

↓
2 instruments
↓
deep into tunnel
pressurize
↓
Start periphery &
come to centre

TDC

Conquer

= 100-280
= 40
= 25-25
Bottle Ht = 3-4ft
4m eye level
Pulse Mode

4m

↓ power in
CST

- Holding of Nucleus Quad & pull in CST
- PhacoAsp of Quad.

CDC

Depth of groove — Wider
Width —» peripheral

Tech of Phaco & pure Nuclear

Phaco Chop

Lens Quake

Sechopping

Horizontal

Vertical

Peripheral

Central

Modified peripheral chopping

a) Nagahara's Phaco Chop tech

b) Stop & Chop tech

c) Chop & debulk tech

d) Choo Choo Chop & flip

e) Phacodrill

f) No Vaccum Chop.

- Phaco Clock
- Phaco Quick Chop
- Stop, chop, chop, stuff
- Phaco Snap & split

✓

↓ Ax time
↓ Total phaco Energy
↓ PCR
↓ Corneal complication

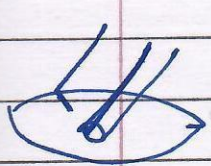
Setting — Tip – 0° degree
Vaccum – 80 ↑ 90
flow = 24
Power = 40 ↑ 50 ↑ 60
Mode = Burst

(a) Peripheral Chopping

- Stabilization of Nucleus
- Creation of Vaccum Seal & V. hold.
  - ↓ Embed tip Being to 2
  - Poor hold — Superficial grip, Position ↓ for long, Inadequate Vaccum, Soft Cataract
- Peripheral Chopping Manoeuvres
  - Blunt Chopper
    - Engage in Centre
    - ↓ Keep making pic.

Impaling tip of body of Nucleus

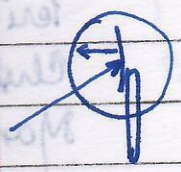
- Without Trench
  - ↓ 0° tip
- With ½ trench
- With complete trench





(X) of Peripheral Chop → Tech difficult
Radial AC tear
PC tear — Long Chopper
Unstable AC
Soft Nucleus

- Central
  » emphasis on Splitting



Split the Nucleus

- Modified Peripheral chopping.

Pulling split Nucleus out of ccc & then eating it

Vertical chopping

Concept — Vertical forces to fragment Nucleus

Tech Phaco Quick Chop

Salient pt — Lift Nucleus vertically & split it

✓

x need to take chopper out till Eq Margin under Ant Cap.

x

Only in moderate density Cataract

Adv.

Disadv.

Lens Quake

↓

15° bevel – auto crack phaco tip.
15° Curve up

Fe-chopping Tech

↓

Akahosi peechopper

Epinuclear plate

Settings

Flow rate - 15-20 cc/min
Vaccum - 75-100 mm of Hg
Power - Min.
Mode - Pulse / linear

- Delicate phase
- Chip & flip tech

Cortical Aspiration

- Automated irrigation & Aspiration
  - Co-axial
  - Bimanual
    - Side port
      - ✓ - Subincisional easy to remove even smaller frag
      - ✗ - Need to make side port Ambidexterous
- Bimanual I & A
  - ↓
  - SimCoe's as SICS

? to remove 12 O clock.

- Use of L tip
- Cortex resistance to Aspiration by Visco
- Aspiration of Very resistant. Cortex. after IOL Implantation

Capsular Polishing

Prevent PCO

- Use of polisher
  - Rounded.
  - Sand blasted
  - Ring Capsule
- Cap-Vac Model

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IOL implantation & Completion

Steps

- Foldable
- Non foldable
  - Injector
  - Holder system

↓

Aspirate OVD

↓

Seal main incision

↓

Subcon injection of A.B

↓

Patching

Visco Inj — Capsule margin clear → blue

↓ ↓

K/C/O Yawn Reflex.

PMMA Optic

- 5.5 »
- 6. glass

↓ ↓

Incision size 3.5 mm

New in Cataract Sx
or
Micro Incision Cataract Sx

Apu incision 1·5 mm at presently 1·8-2·2 mm

- Micro Incision Phaco
- LASER phacolysis
- Aqualase
- High aspiration Controlled Chop
- Catarex Tech.

Micro Incision Phaco

- Smaller incision
- Improved fluidics
  - ↓ Effective Phacotime
  - ↓ Trauma
  - Stable AC
- ↓ SIA
- ↓ Astigmatism
- Fast Post op recovery
- Excellent Visual Recovery
- ↓ Incidence of later Corneal decompensation

Types

- Biaxial (Bimanual)
- Coaxial

(i) BIMICS

thru 2 μincision

Irrigation — Aspiration of ↓ size <1mm

PhacoNit — Microphaco

PhacoNit: 1mm | 0.7mm (μphacoknit)

Microphaco: 0.8mm, 21g irrigation chopper

Fluidic Modulation

Incoming > Outgoing

Fluidic Modulation
- ID > OD
- flow rate & Vaccum to be tone down
- Stable Incision
- ↑ Irrigation method
  - fish pond pump
  - Additional IOM
  - Use of air pressurized bottle of BSS
  - Bottle Ht extenders
  - Mech Pressure infusion

Phaco Power Modulation
- Pulse
- Burst
- Micropulse

Surge Prevention
- ↑ Irrigation
- Slow pace of Sx
- Use of ↓ compliant tubing
- ↓ dia tube pump
- ↓ dia phaco tips

Tech

Incision 1-1.5mm at 10 O clock & 2 O clock

Capsulorrhexis — 26G Needle Cystitome

Nuclear phaco — Irrigating chopper
sleeveless phaco probe
Phaco Machine

Cortex removal

IOL Insertion — 2 incision enlarged to 1.8 mm

Disadv → ↑ risk of chamber instability
- ↓ fluid parameters
- Absence of protective effect of silicon sleeve

Coaxial

Conventional phaco thru 1.8-2.2 mm
just to ↓ learning curve of B/MICS

- Harder Phaco sleeve than Conventional
- Bottle Ht — 80-100 cm.

Peristaltic		Venturi
35-60	Flow Rate	
400	Vacuum	350-500

TECMIS

Fully Endo Capsular Micro Incision Cataract Sx.

↙ Corneal Incision ⟶ ↘ Micro Capsulorrhexis

↓

Endo Capsular Phaco

US power — 10-40% | Burst Mode — Tunnel.
Pulse — Emulsify

Entire Sx in Bag

✓✓ ↓ Corneal damage
If PCR occurs then also many options
Maintain integrity of lens in Subluxated lens

(B) (LASER Phacolysis)

- ↓↓ Production
- Small & safe wound

Nd YAG ⟶ Direct acting System ⟶ Photon LASER Phacolysis (+)
Nd YAG ⟶ Indirect acting System ⟶ Dodick LASER. (Need of cooling −)
Er:YAG ⟶ Phacovaporization

3 Tech

- Bisecting & Lasing (Dodick Tech)
- ÷ & Conquer tech of Needab
- Corneal Nucleus ablation tech of Kent

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BIMBIE Binanual Bienergy Tech for Cataract extraction

- US fragmentation Irrigation
- Laser Phacolysis & Aspiration

- Aqualase.
  - Small pulses of Bothcat fluid is used
  - ✓✓
  - ↓ risk of PCR
  - No Corneal Wound
  - ↓ chances of PCO
  - Faster tech
- High Aspiration Controlled Chop (HACC)
  - Be-Chop MICS
  - O phaco tech
  - × phaco only ≤ 1A
  - ✓ Thermal burns
  - ↓ Endothelial loss
  - ↓ PCR.
  - Universal application
  - ↓ Cost MICS
- Catarex Technology
  - Vortex Phaco
  - ✓ – faster
  - ⇒ use when injectable IOL. comes

Femto Cataract

Intro — Zero error

- Mech — Inflamed
- (Uses) — Creation of corneal flap for LASIK
  " tunnels for ICRS
  Arcuate incision to correct Astigmatism
  Corneal Keratoplasty incisions

Steps

Pre-femto → DCT

Femto LASER.
- CCC at 500µ AC depth
- Base fragmentation + 1000µ Above PC
- 1 & 2° corneal incision
- Arcuate " "

Post femto

(X) → Capsular Blockage Syndrome

Limitation
- ↓ in deep Set eyes
- Other inflammations
- ↑ in IOP
- Diabetic — PED
- Poor dilation — poor Candidates
- Phaco-donesis & Zonular dialysis
- Cost

Small pupil <4mm

- Hyporeactive
  - Hypermetropes
  - DM
  - PEX
  - Elderly
- fixed
  - Chronic Pilocarpine Rx
  - Post synechiae in Uveitis

Spl Situations

- Small pupil
- Subluxated Cataract
- Pseudo exfoliation Syndrome
- Cataract in Uveitic eyes
- Morse Cataract
- Traumatic
- Post Refractive Sx.
- Posterior Polar
- Paediatric

(a) Small Pupil

Non dilating < 4mm.

Causes →

- Advanced age & arteriosclerosis
- Post Uveitic
- Pseudoexfoliation Syndrome
- Prolonged Miotic therapy
- High hypermetropia
- Diabetic patients
- ARP.

Anticipated Risks

- difficulty in each step of Sx
- Post op Inflammation due to excessive iris manipulation
- Iris trauma
- Perop & Post op hyphaema
- Post op glaucoma
- Post op Mydriasis — Temp / Permanent

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Mx

Pre-Op

- Preop
  - Educating pt.
  - Max. pupil dilation.
    - Discontinue Miotics
    - Topical NSAIDS before Sx
    - Topical mydriatics
  - Prevent hyphaema
    - Stop aspirin
    - Anticoagulant
  - Post op inflammat
    - Topical steroid
    - Oral steroid
    - hydroPHOBIC IOL
- Anaesthetic
  - Prefer Peribulbal block.

Post op

- Post op inflamma & CME
-
- Post-op glaucoma

Pre-Op

Wound Consideration

- Ant Corneal incision given
- Scleral tunnel / limbal approach if conversion to ECCE

Visco elastic Consideration

↑Mort to aid in pupillary dilat"
Synechiolysis
Hemostasis

Consideration during Capsulorrhexis

↳ By mechanical retraction of pupil
↳ CCC under air filled AC
↳ Good control of rhexis

During hydro-dissect"

↓
gentle & good rotation

During Nuclear Emulsification

↓
Phaco - Chop
Pupillary plane
↓ Phaco parameters

For Thorough Cortical clean

- Kuglen hook
- Y hook

To enlarge Pupil Size

Mackool (Tita)
Jaffe (Nylon)

Synechiolysis

↓
at times peel off cyclitic Memb

Stretch pupilloplasty

↓
Y Hooks
Kuglen Hooks
4 pt pupillary dilation

Use of iris retractors or hooks

Surgical measures

Mcrohook.
Koush (Katena)
Beehler's pupil dilater (Moria)

Use of iris retractors/other devices

- Flexible iris retractors or hooks
  - Nylon
  - 4 Equidistant disposable
- Mackool self retaining titanium Mechanical hooks
  - Titanium
- Malyugin Ring
  - Rectangular device 5-0 prolene Scroll principle

- Hydroview iris protector Ring
  - Hydrogel Ring
    - inserted in AC in dehydrated form
- Graether pupil expander
  - pupil expander
  - Inserter
  - iris glide retractor
  - soft silicon Ring
- Morcher Pupillary dilator
  - PMMA. ring

Surgical Measures

- Multiple Sphincterotomies
  - Vannas
- Radial iridotomy
  - Keyhole pupil from 6, 12 O clock
    - Mc Canel Suture

Subluxated lenses / Zonular dialysis

Considerations

Pre-Op.

- Determine predisposing condition
- Zonular defect assessed
- Vitreous loss +/-
- Phacodonesis +/-

Anaesthetic.

- GA in children
- Avoid stress on Zonules

Peri Op

Incision

- Incision site → Avoid zone of subluxation
- Scleral window → Incut in zone of L. dissection if sutures anticipated

Capsulorhexis

- Visco Cohesive to tamponade vitreous
- Vitrectomy - 2 port system - Mydriated ✓
- Initiation of CCC away from dialysis
- Advancement of flap in tangential direction
- 6mm CCC

Hydrodissection

- gentle & thorough cortical cleavage

Phaco

∝ on clock hr.

Nucleus Mx

- Slow motion phaco
- Soft Nucleus - chop & flip
- Mod-hard - phaco chop tech
- 2 port Ant Vitrectomy if Vitreous in AC at any stage

Cortical aspiration

- Visco dissection
- Bimanual tech
- Tangential traction move"

IOL implantation

- Large dia lens >6mm
- CTR Ring
- Orientation of haptic // to dialysis
- ↓ dialing move"
- Sulcus placem"

CTR

Surgical recommendations

- Mild (<3 clock hr) → Phaco
- Moderate (3-5) → CTR
- Severe (upto 7) → Modified CTR or Cionni's

Types of CTR

known as Equatorial Ring or Endo Capsular Ring

Mode of PMMA.

Uses — Zonular dialysis
Subluxated lenses
to ↓ proliferation of Equatorial epi Cells

Principle → Traction - expansion
Stabilization.
Maintain Circular contour of Bag despite Zonular dehiscence.

Types

- Mordhes — M.C
- Cionni → Modified CTR → for scleral fixation
- Henderson CTR → Open C loop → Indentation all around allow easy Nucleal & Cortical Mx
- Ahmed CTR (Segment) → • Support also • PCR occur

Nyachei

	14	14C	14A
	Paediatric Nucleospheric	Normal eyes	High Myope.
AL	<24	24-25mm	>25
WTW	<11mm	11-12.5	>12.5
Dia → Ex Comp	12.3 10	13 11	14.5 12.

Time of Insertion

- Before hydrodissection
  - ✓ → Can visualize Proper place"
  - x → Req Cortical clean up
- After hydrodissection
  - ✓ — keep bag stretched
  - — x collapse of fornix
  - ↓ Vitreous prolapse
  - Better IOL centration
- After Cortical clean up
  - ↑ automated I&A.

Tech of insertion

- Manual
  - Mc pherson.
  - dialer in Side port hook eyelet of CTR
  - don't leave unless below rhexis margin
  - Final position → Convex part about area of deficient L.
- Help of injector
  - Jender CTR injector

Cionni Ring

5-7 O clock.

Scleral Window — Recut ✓

↓

Cionni Ring fixed ⊆ help of transcleral 9-0 prolene suture & thru scleral Window

↓

Eyelet higher plane 0.25mm. forward.

∴ lie over the Capsule.

CI

Capsular tear ┌ Ant
              └ Post

Incomplete Capsulorrhexis

Severely. > 7 O'clock Re — ICCE ↷ Ant Vit

↓

ACIOL / Scleral fixated PCIOL.

Pseudoexfoliation Syndrome

Problems	Consideration
Zonular breaks	Exfoliative glaucoma
Subluxation of Lens	Poor pupillary dilation.
Poor pupillary dilation.	Zonular weakness / subluxated lens
Secondary glaucoma	

Uveitic Cataract

Appropriate work up.
- Cause
- Corneal Endo Status
- Pupillary fibrosis +/-
- IOP record
- Post Seg Exam

Less tolerance of inflammation

2 mths before Sx.

Visual prognosis — guarded.

PreOp Rx → steroid cover 3 days before.
- Continue pre-op Immuno suppression
- Ensure IOP control
- Topical AB & NSAIDS
- Proper dilation.

Dense Cataract

PreOp

Challenges
- Hard & Sticky fibres
- Thin Capsule
- Weak Zonule
- ↑↑ Mass of Nucleus
- Poor floppability ↑↑ chatter

→ grade of Nucleus
- Info to Pt
- Pupillary dilation & maintenance
- Peribulbar block.

Anticipated risk
- ✗ able to complete CCC
- Incision burn
- C. Edema.
- PCR.
- ↓ IOP.
- Iris trauma
- CME

Post Polar Cataract

Wheel like pattern

Risk of PCR.
- Meticulous slit lamp exam
- Defer Cataract Sx
- Proper information & counselling
- Preparation of Ant Vitrectomy
- Pupillary dilation & its maintainence
- Peribulbar block.

- Peribulbar block
- Visco → Protect Endo.
  ↓ trauma to iris
- Mx Narrow pupil
- Large CCC to prevent risks of Capsular Contraction Syndr
- Phaco Chop tech
- Thorough Cortical aspiration
- Capsule polishing
- IOL in the bag
  × ACIOL × Hydrogel
  ✓ Heparin surface modified to ↓ inflammation
  × IOL in pt ⊆ JRA pt as fibrotic bands causes distortion of pupil
- Intracameral Hydrocortisone
- Inj of Triamcinolone

Op

Short scleral tunnel than CCC to prevent thermal burns

Temporal »

Soft shell Tech

CCC neither large nor small

Gentle Hydrodissection × delineation

45° tip for phaco.

Spl handpiece

Mackool | Kelman flared Mackool ABS tip. | Transverse Usg & Rotational Ozil tech

Parameter — ↑ flow rate, ↑ phaco power

Pulse/Burst

Tech — Phaco Chop
Sculting deep Central Zone
Vertical chop
Bevel down Phaco (Phacodrill)
Transverse Crack & Scleral chopping

Scleral tunnel
Capsulorrhexis adequate
× Hydrodissection
Hydrodelineation ✓
× Nuclear rotation
Phaco → ↓ AC fluctuat°
– generates Visco
↓ Bottle Hl-
Chopping tech
Epinucleus & Cortex to be removed from periphery
Centre at last – may be left – Nd YAG
Mx of tear – Dry Asp Viteectomy

IOL
× tear → in Bag
✓ tear, × Vits → in Bag, ✓ Vitrect

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Post Op

Prolonged C. Edema → Hypersol steroid

» Inflammation
- Intensive steroid Rx
- Use of Cycloplegic
- Use of Oral steroid

Wound burst → W. leak & by
- Aq. suppressant
- Pressure patching
- BCL
- Wound revision

CME

Aftercare Procedure

↓

ECCE/ICCE if :-

Pre Op poor Endothelium.
Weak zonule.
1 eyed pt
Bilateral Vitrectomy
Advanced Cataract

) Aggressive Rx of Inflammat"
Topical steroid 3-4 m/th
" NSAID x1 m/th
Oral " 4-6 wk

) Frequent Post op follow up

) Watch on pigment deposits on IOL surf

B

- Tear small → ↓ In Bag
- AC ✓ PC x → ↓ In Sulcus
- AC x → Scleral fixated ACIOL

- Residual Post Capsular plaque
- Trapped Nucleus

Post op ↑ IOP

Post op Inflammat"

Post op CME

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Cataract Sx in Post Refractive Sx Pt

Anticipate

- difficult true corneal power
- dehiscence of refractive keratotomy incisions
- Transient refractive shifts
- Risk of bullous keratopathy
- ↑ risk of retinal hole, tear, detatchment

Mx

Pre.

Corneal pt
- Power error
- Diurnal fluctuation
- Power by diff method

Pt
use Corneal topography

Myope → Use flattest K → Use highest calculated power

Hyperemetrope → Steepest → least power

Intra Op.

- Avoid cut across K. incision
- Consider Sclerocal tunnel incision
- Avoid crossing interface
- Consider combined transplant

Post Op

- Bullous K
- Unexpected Refractive Error → May req. lens exchange

Intra Ocular lens implantation in absence of PC support

1°

Large PCR ≤ x AC
Accidental ICCE
Accidental aspiration of Bag
Explant of dislocated IOL
Zonular dehiscence > 3/4th area
IOL exchange of ACIOL.

2°

Planned ICCE
Accidental ICCE
Post dislocation of IOL-Caps.
" " " " Crystalline lens

Options

AC IOL

- Angle Supported
- Iris Supported

PC IOLs

- Iris fixated
  - Peripheral Iris fixated
  - Sutureless → Sinderflex.
- Trans scleral fixated
  - Suture fixated
    - Tech of Trans scleral suture fixation
      - Conventional
        - Ab interno
        - Ab externo
      - Endoscopic
        - Bimanual Method
          - Ab Externo
          - Ab Interno
        - One hand tech.
  - Suture less → glued. (Intrascleral)

Pre-Op

a) Anxiety — Anxiolytics

b) Nausea & gastritis — Antacids

c) Irritative/Allergic Conjunctivitis — Postpone drugs

d) Corneal Abrasion — Patch for a day

e) Due to LA
   - ↳ Retrobulbar Hmrg — - 2% pilocarpine → Pressure bandage; - Lat Canthotomy
   - ↳ OculoCardiac Reflex — - i.v Atropine
   - ↳ Perforation of globe
   - ↳ SubCong. Hmrg
   - ↳ Spont dislocation of lens

Operative Complications

- Superior Rectus Laceration
- Excessive bleeding
- Incision rel Complications

Conventional ECCE

In Scleral Corneal tunnel during SICS & phaco

→ Thin flap & button holing of Ant Wall of tunnel (center for other plane)

→ Premature entry into AC — New dissection

→ Scleral disinsertion —

→ Complication ≤ CC Incisions →

- Thin flap & button holing of Ant Wall
- Torn edges
- Premature entry
- Complication during side port incision

↓

Too far peripheral paracentesis

Side port incision too far central into the Cornea

Side port incision too small for instrument entry

- Injury to cornea
- Iris injury & iridodialysis

- Complication related to Anterior Capsulorhexis Eccentric.

Escaping

Inject Visco

a) Catch & forceps & pull radially

b) Cut the capsule ahead & pull the rest

c) False opp flap

d) Make can Opener.

Small

Predisp

- PCR
- deep.
- Zonular dehiscence

- Inject Visco
- Make oblique cut in rim of capsulorhexis
- Catch the flap & rhexis forceps

Very Large

- Limit hydrodissect
- Use dispas visco-elastic
- Phaco by Beaven tech or Pfeiffer Maloney Tech.

- Complication during hydrodissection

Incomplete hydrodissection

- PCR.

PCR

Fluid misdissection

Shallow AC & ↑IOP

Over inflated eye

↑IOP.

Hydro. & then side port

- PCR
- Zonular dehiscence
- Nucleus drop in Vitreous Cavity
- Suprachoroidal effusion or Hmrg
- Expulsive choroidal hmrg

PCR

Most dreaded during ECCE.

Situations

- During hydrodissection.
  - Forcefully performed hydrodissection
  - Capsular Block Syndrome.
  - Inherent weakness of PC
    - PEX
    - PPC
    - ↑Myopic
    - Traumatic Cataract
    - Post Vitrectomy C.
- By direct injury
  - During Epinuclear plate removal
  - Cortical aspiration
  - During Capsule polishing
- During Nucleotomy
  - ↓ Vaccum setting in safe zone

Signs of PCR

- If PC is caught star shaped area appears
- Sudden deepening of AC
- Momentary pupil dilation
- Non floatability of fragments
- Move away 4m / tip
- During hydro – Pupil snap sign occurs

Mx ∝ Immediate recognition
size of tear
stage of surgical procedure
Associated Vitreous loss

↓

Stop working
Maintain closed chamber
Preserve as much PC as possible

↓

Early stage → ECCE

Late stage

↓ Intact hydrad phase → Plug ± Visco → Nucleus material left
- Small → Move in AC
- Large → enlarge incision take out by sheet glide loop → Remove by Manual dry aspiration & Sim Coc

↓ Vitreous loss + X Nucleus in Vitreous
- Remove lens material as earlier
- Ant Vitrectomy to be done

↓ + + ↓ ± to Nucleus drop

Nucleus Drop

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» Phaco

Can occur at any stage of PCR.

Mx.

↓

X attempt to fish it out

↓

Ant Vitrectomy.
Cortical clean up
Proper wound closure

↓

3 port Vitrectomy

↓

Removal by limbal route

↓

Hard & Complete Nucleus

↓

Inject PFCL to raise Nucleus up

↓

Manipulate lens into AC

↓

Remove by limbal incision

By Phaco frag

↓

Soft & Small dropped lens matter

↓

Inject PFCL

↓

Power – 5-10%
Asp – 150-200mm Hg

Favit

↓

Vitrectomy probe 4mm Caudal incision
Connected to peristaltic pump

↓

Endoilluminator thru side port

↓

Phaco probe via Corneal incision

30% power
50mm Hg suction
18cc flow rate

Suprachoroidal effusion

Exudation frm Choroidal circulation during decompression procedure

Expulsive Choroidal Hmeg

Traumatic & Venous

Etio

Any Dx >>ICCE
↓ in Phaco

Rel closed system

Rel tight fit of Phaco tip incision

» Elderly, DM, Obes, ↑ Myope

Exaggerated form of ←

HTN & Atherosclerotic changes

C/F

difficult to diff frm effusion & hmeg

Spont gaping of wound
↓
expulsion of lens
Vitreous → Retina
Bright Red ← Uvea
Blood

forward prolapse of Post Ocular structure including Iris & vitreous
shallowing of AC
Change in Red reflex
Operative hand eye → Pt agitated

Mx

Rapidly close incision
↓
Drain blood by doing equatorial sclerotomy
↓
Evisceration

Mx

Closure of Wound
Hyperosmotic Agent
Post Sclerotomy
Topical Antiglaucoma drugs

Post Op Complications

- Hyphaema. —— If ↑ IOP — ℞ by Anti glaucoma
  If > week — Paracentesis

- Iris Prolapse —
  - Small (< 24hrs) → Reposit back
  - Large (>) → Abscission & Suturing of Wound.

- Flat AC
- Corneal Edema
- TASS
- Endophthalmitis
- CME
- RD
- Epithelial ingrowth
- Fibrous Ingrowth
- After Cataract
- Post op glaucoma
- IOL related Complications
  - CME
    Endothelial damage
    Uveitis
    2° glaucoma
  - Decentration
    Subluxation
    Dislocation
    - Sunset
    - Sunrise
    - Windshield Wiper
  - Pupillary Capture

Flat AC

- Wound leak.
  - ↓
  - Hypotony
    - ↓
    - Rx by Pressure bandage.
      Oral Acetazolamide
- Choroidal detachment
  - Pressure Bandage
  - Suprachoroidal drainage & injection of air in AC
- Pupil Block

↓ Patho

- ↓
- Rt/o Bombe
  Shallowing of Peripheral AC
  - ↓
  - 2° ACG

↓ Etio

Vitreous bulge fall PCR
ACIOL & cord PI

↓ Rx

Mydriasis
Hyperosmotic
↓
of seq. PI.

Corneal Edema

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Predisposed in Fuch's

Damage to Endothelium
- Mechanical – lens fragments
- Chemical – Irrigating OVD & Visco
- Thermal – use of phaco power

Intraocular Inflammation
Uveitis ± Associated Endotheliitis

Post op ↑IOP

Some facts

Periphery clear
Resolves ± time

Edema after 3 mths
x Clear

Chronic
Bullate Keratopathy
DM fold +

Irvine Gass Syndrome
Vitreo Corneal adhesion
CME
C. Edema.
foll. ICCE
Vitrectomy

Pseudophakic Bullous Keratopathy

Beaver McLean Syndrom
Peri C. Edema ± clear centre
Punctate Beaver pigment

5% NaCl

↓

BCL

↓

PK | EK

↓

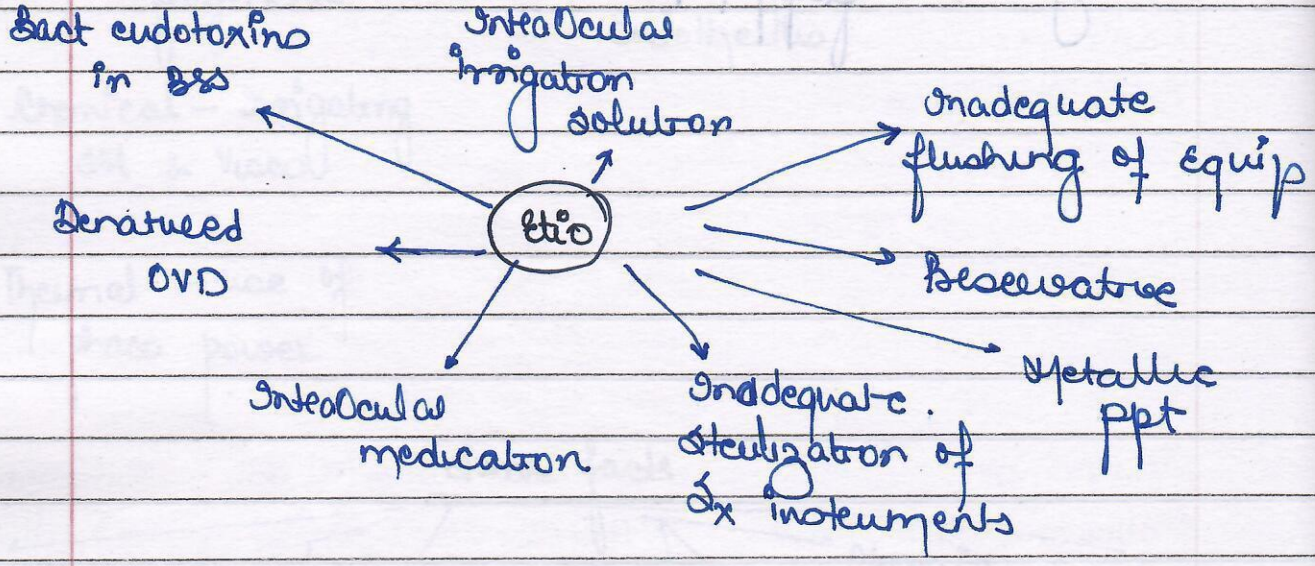
Gundesen flap | AMT.

TASS

Acute severe intraocular inflammation acc by diffuse Corneal edema

↓

12-48hrs after Sx.



Cf

Symptom

↓ Vision
Pain
photophobia.

Sign

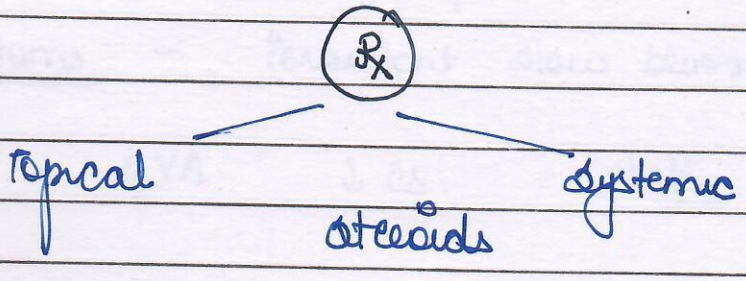
Limbus – limbus C. Edema
dilated pupil.
IOP ↑.
Severe inflammation in AC.

Dod

Endoph.
Retained lens material
Uveitis

Prevention

Use of proper BSS
good filtration of BSS
Avoid any kind of preservative
Use of fresh OVD.
Adequate sterilization
Well aware SOPs



Posterior Capsular Opacification

After Cataract — 5-50% — Senile C.
2° Cataract — > Myopic
40% in Children c P.

Proliferation of lens epithelial cells remained in Capsular Bag — IWK of Sx — Pmy

↓ if Capsulorrhexis opening is in complete contact ≤ Ant surf of IOL

> PMMA
↓ ≤ Sq. edges lenses
Hydrophilic

Symptoms — Persistent slow blurring
↓ VA. ↓ CS.

RoF — Residual Cortical matter
Iris pigments & cells lost
due to Breakdown of Aq. Barrier

Signs

Vacuolated PCO (Pearl type)
↓
Proliferating Swollen lens epi cells
↓
of gp into clusters at edge of Capsulotomy
↓
Elschnig Pearls
↓
Hirschberg Elschnig Pearls
↓ if after AC Trauma/ Traumatic

Fibrosis type
↓
fibroblastic metaplasia of epithelial cells
↓
Wrinkles

Sommering Ring
↓
Whitish annular dough shaped Mass
proliferation of residual cells

Prevention

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Rx

Children — Thick — Viteeous Cutter
Tough / Non pliable — Cut Into small pieces

Non Invasive

Invasive → Viteechomy

Ziegler knife — V. Scissor.

Q Switch Nd YAG Capsulotomy

1mJ / pulse (1·5 - 2mJ/p)

Ix
C/I — Leucoma.
C. edema
Prelase Exam protocol
focus setting.

PCO ↓ VA

— Cuneate pattern
Christmas tree pattern
Reversed Hexagonal C. tech

Pseudop → Post defocus setting

Aphake → Ant defocus

— Can Opener
— Inverted U
— Circular pattern

Viteeous Steand Cutting.

Aim at 150μ post from a datum pt to avoid IOL damage.

RD.
CMO
Lens displacement
↑IOP

(total < 80 mJ)

IOL putting.

Age
Surgeon
Sx tech
type of IOL
Duration after Sx.

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Pathogenesis

PCO results from migration & proliferation of residual lens epithelial cells (LECs) onto central posterior capsule (> proliferat^{n} in young)

- A → Anterior epithelial cells → If disturbed → Tend to remain in place x. Migrate → Transform into fibrous like tissue (Pseudofibrous Metaplasia)
- E → Equatorial → Source of classic PCO Elschnig pearls → ✓ posterior (Pearl form) → x metaplasia → form ballon like. Bladder cells (Wedl)

Also. Sommerring's → Precursor of Classic PCO.

Doughnut shaped lesion composed of regenerated Cortex & cells

Pathio → Ant Capsular Break
ECCE done

ACO
Anterior Capsule opacification

ILO
Intellentacular opacification

Piggy Bag Lenses.

Grades of PCO

Grade I
- Thin veil like
- detailed visualizat" of disc
- Min distortion

II
Slightly thicker
Hazily seen.
fundus x clear

III
Thicker.

IV
x glow seen.
Only peripheral fundus seen

TGF β, FGF2 has role.
& role of various adhesion molecules

Cortical clean up

Polishing of AC

Buttonholing of Post Capsule

Prevention

Surgery related.

Hydrodissection enhanced Cortical clean up.

↓

Hydraulic force remove LEC

On the bag IOL fixation

Capsulorhexis slightly < than dia of IOL optic

IOL related

Hydrophobic

Use of Bio Compatible IOL to ↓ stimulat^n of Cellular proliferat^n

↓

Sandwitch theory

Enhancement of Contact b/t IOL optic & Post Capsule

↓

No Space

No Cells

Post Latron 5-10°

Use of IOL ⊆ Square & truncated optic edge.

↓

Ant edge round to prevent dysphotopsia

Recent

Sealed capsule Irrigation for PCO prevention.

↓

Nulvella (Sydney) → Perfect Capsule

↓

Supporting Sol in Research

7mm device

5mm Capsulorhexis



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Therapeutic Agents —

- Anti proliferative
- Anti Coagulant
  - Heparin
- Anti Inflammatory
  - Indomethacin
  - → Diclofenac Na
  - Cyclosporin A
- Anti adherance & Anti Migratory
  - → Batimastat — MMP
  - — Nibefradil — Ca Channel Inh.
  - — RGD peptide
  - — EDTA.
  - — Coating of IOL surface by MPC polymer