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Challenging the Challenges in Phacoemulsification Surgery

Instruction Course Handout – A Guide to a Perfect Outcome

Course Objective: To equip ophthalmic surgeons with the decision-making frameworks and surgical techniques necessary to manage complex cataract cases safely and effectively, transitioning from routine to master phacoemulsification.

1. INTRODUCTION

Phacoemulsification has evolved into a refractive procedure where patient expectations are extremely high. While routine cases yield excellent results, challenging scenarios—whether anatomical (small pupil, weak zonules) or pathological (dense cataract, IFIS)—can threaten outcomes. Success lies not just in surgical dexterity, but in meticulous pre-operative planning and the ability to adapt intraoperatively.

2. PRE-OPERATIVE ASSESSMENT & PLANNING

Patient Evaluation Checklist

- **Cornea:** Endothelial count (specular microscopy), guttata, scars.
- **Anterior Chamber:** Depth (ACD), clarity.
- **Iris/Pupil:** Dilated pupil size, response to light, pseudoexfoliation (PXF), transillumination defects.
- **Lens:** Grading (LOCS III), phacodonesis (slit lamp examination in undilated and dilated states).

Identifying "Red Flag" Cases

- **Small Pupil (< 4mm):** Risk of iris trauma, poor visualization.
- **Hard Cataract (Brunescent/Black):** High energy required, corneal burn risk.
- **White Cataract:** Pressurized bag (Argentinian flag sign risk).
- **Zonular Weakness:** PXF, Marfan's, trauma history.
- **Deep/Shallow AC:** Nanophthalmos vs. High Myopia.

3. CHALLENGING SCENARIOS & MANAGEMENT

A. Dense Brunescant & White Cataracts

Dense Brunescant

- **Technique:** Vertical Chop or Multilevel Chop preferred to reduce phaco energy.
- **OVD:** Use Dispersive (Viscoat) to coat endothelium ("Soft Shell Technique") and Cohesive to deepen chamber.
- **Machine Settings:** High vacuum, burst mode/pulse mode to avoid chatter.
- **Tip:** Create a large rhexis (5.5-6.0mm) to allow manipulation of large fragments.

White Intumescent

- **Risk:** "Argentinian Flag Sign" (capsular tear extension).
- **Management:**
 - Stain capsule with Trypan Blue.
 - Decompress the bag with a 27G needle aspiration of fluid cortex before initiating rhexis.
 - High viscosity OVD (Healon GV) to flatten anterior capsule.

B. Small Pupil & IFIS

IFIS (Intraoperative Floppy Iris Syndrome): Associated with alpha-blockers (Tamsulosin).
Triad: Floppy iris stroma, propensity for iris prolapse, progressive miosis.

STEP-WISE MANAGEMENT APPROACH

1. **Pharmacological:** Intracameral preservative-free Phenylephrine (1.5%) or Epinephrine.
2. **Viscomydriasis:** Use Healon GV or Healon 5 to mechanically expand the pupil.
3. **Mechanical Expansion:**
 - *Iris Retractors (Hooks):* 4 hooks in diamond configuration. Good for stability.
 - *Pupil Expansion Rings (e.g., Malyugin Ring):* Easier to insert/remove, gentle on iris margin.

C. Zonular Dialysis & Weak Zonules

- **Signs:** Phacodonesis, deep/asymmetric AC, visible lens equator.
- **Surgical Strategy:**
 - Avoid rotation of the nucleus if possible.
 - **Capsular Tension Ring (CTR):** Insert if dialysis < 4 clock hours. Stabilizes the bag and distributes forces.
 - **Cionni Ring / Ahmed Segment:** For dialysis > 4 clock hours (requires scleral fixation).
 - **Chopping:** Vertical chop reduces zonular stress compared to divide-and-conquer.

4. SURGICAL TECHNIQUE OPTIMIZATION

A. Incision Construction

The foundation of fluidics stability.

- **Architecture:** Square or near-square (e.g., 2.2mm width, 1.75-2.0mm length).

- **Location:** Temporal clear corneal incision (CCI) is standard; creates less astigmatism.
- **Integrity:** Ensure roof and floor are equal length to prevent wound leak and chamber collapse (leads to surge).

B. Capsulorhexis Mastery

- **The Goal:** 360-degree overlap of the IOL optic edge (prevents PCO and ensures effective lens position).
- **Rescue Technique:** If the tear begins to run radially, stop immediately. Fill AC with cohesive OVD. Use Little’s Maneuver (pull backward and centrally) to redirect the tear.

C. Phacoemulsification Parameters

Step	Vacuum (mmHg)	Flow Rate (cc/min)	Power Mode	Goal
Sculpting	Low (40-60)	Low (18-22)	Continuous	Create groove without grabbing nucleus.
Chopping	High (350-450)	High (30-40)	Pulse / Burst	Hold nucleus firmly to chop.
Quadrant Removal	Mod-High (300-400)	Mod-High (28-35)	Pulse / Torsional	Efficient followability.
Epinucleus	Low (150-200)	Low (20-25)	Low Pulse	Safety for posterior capsule.

5. INTRAOPERATIVE COMPLICATIONS - QUICK REFERENCE

Complication	Recognition	Immediate Management	Prevention
Posterior Capsule Rupture (PCR)	Sudden deepening of AC, inability to rotate nucleus, vitreous in AC.	STOP foot pedal immediately. Do not withdraw phaco tip (chamber collapse pulls vitreous). Inject OVD through side port, then withdraw tip.	Proper hydrodissection, avoid surge, slow motion phaco.
Zonular Dialysis	Equator visualization, lens tilt, gapping of bag.	Insert CTR early. Use capsular hooks for support during phaco.	Identify PXF pre-op. Gentle maneuvers.
Descemet’s Detachment	Visible membrane near wound.	Avoid inserting instruments that catch the membrane. Air bubble tamponade at end of case.	Sharp keratomes, proper entry technique.
Nucleus Drop	Nucleus disappears into vitreous.	Perform anterior vitrectomy to clear wound. Close wound. Refer to retina specialist. DO NOT FISH for fragments.	Adequate hydrodissection, stop if PCR suspected.

6. KEY PEARLS FOR PERFECT OUTCOMES

- **Hydrodissection is Key:** Ensure a free-rotating nucleus before starting phaco.
 - **Respect the Endothelium:** Re-coat with dispersive OVD during long/hard cases.
- **Trypan Blue:** Use liberally in white cataracts or poor red reflex.
 - **Soft Shell Technique:** Dispersive OVD first (coats cornea), Cohesive OVD second (flattens capsule).

- **The "Safe Zone":** Keep the phaco tip in the center of the pupil and at the iris plane. Never hunt for fragments near the capsule.
- **Maintain Chamber Stability:** Avoid incision leak. Raise bottle height if high vacuum is used.
- **Wound Check:** Hydrate incisions well. Seidel test at the end is mandatory.
- **IOL Selection:** In PCR, Sulcus IOL (3-piece) is preferred. Optic capture in rhexis provides best stability.
- **Don't Panic:** In case of complication, pause, fill with OVD, and assess. Rushing worsens the situation.
- **Ergonomics:** Ensure patient head is flat (chin up slightly) for good red reflex.
- **Side Port:** Make it small (1.0mm) to prevent fluid egress during chopping.
- **Followability:** If fragments don't come to the tip, check for wound leak or low bottle height.
- **Vitreous Stain:** Use Triamcinolone acetonide to visualize vitreous prolapse in PCR.
- **Second Instrument:** Your chopper/dialer protects the posterior capsule during quadrant removal.
- **Know When to Convert:** Converting to SICS or ECCE is not a failure; it is a safety decision.

7. RECOMMENDED EQUIPMENT & VISCOELASTICS

Viscoelastics (OVDs)

- **Cohesive (e.g., Healon, Provisc):**
Maintains space, easy to remove. Good for bag inflation & IOL insertion.
- **Dispersive (e.g., Viscoat, Endocoat):**
Coats tissues, resists aspiration. Essential for endothelial protection in hard cataracts.
- **Visco-adaptive (e.g., Healon 5):** Best for small pupils and maintenance of deep AC.

Ancillary Devices

- **Capsular Tension Rings (CTR):** Standard and Cionni types.
- **Iris Hooks:** Reusable or disposable (nylon).
- **Malyugin Ring:** 6.25mm or 7.0mm.
- **Vitrectomy Cutter:** Anterior vitrector setup (high cut rate, low vacuum).

8. REFERENCES

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