This course discusses strategies to avoid and manage some intraoperative complications encountered during the various stages of femtosecond laser cataract surgery.

1. Docking

Docking affects quality of incisions, capsulotomy and fragmentation

- When docking the patient, check that the plane of the eye is not tilted, i.e., in the same plane as the plane of the patient interface

- A flatter anterior capsule plane ensures that the predefined band of laser beam can cover the lowest and highest anterior capsule points completely and thus facilitates free-floating capsulotomies

- For femtolaser systems using fluid interfaces, check that there is adequate fluid in the interface and no leakage from the side of the suction clip

- Dock slowly to avoid sudden applanation which can induce cornea folds.

- Undock and redock if the eye is not centered

- If there is suction loss, discontinue, and proceed with manual surgery

2. Incisions

- The beginner femtocataract surgeon may find the femto incision more difficult to open compared to the regular keratome incision.
**Practical Tips**

- **Lasered incisions:** Understanding incision configuration: main incision profile is usually triplanar whilst sideport is uniplanar
- **Key is to identify the lasered lamellar planes and not create a false passage**
- **Expect some resistance on entry compared to keratome incisions**
- **Imperforate Incisions:** If incisions cannot be opened easily, it is useful to have specific designed spatulas to blunt dissect and open up femtolaser incisions
- **Incisions should not be located outside clear cornea in the limbus, areas of dense arcus senilis or pterygia as they will not be patent**
- **Incisions may be created too centrally especially if trying to avoid peripheral arcus; also, different laser platforms position their incisions differently and surgeons need to be familiar with their femtosecond laser platform to know where to place the incision and to adjust it with each patient**
- **Femto incisions may be more prone to edema than blade incisions**

3. **The femtosecond laser anterior capsulotomy**

   The aim is to deliver a completely round, free-floating and well-centred capsulotomy. Incomplete capsulotomies, represented by capsular tags and bridges are one of the most common surgical hurdles encountered. Capsular tags arise due to pinpoint uncut areas. Bridges occur when there are larger areas of untreated capsule, i.e. “skip” areas.

   **Why is the capsulotomy incomplete?**
   - “Hard” docking: Cornea folds develop when there is too high/uneven applanating pressure (very hard contact corneal applanation for contact laser systems or inadequate fluid in liquid immersion laser systems) leading to corneal folds which can interfere with the laser beam's path
   - Uneven docking causing tilt, so that the anterior capsule cross-section is not flat and laser treatment band is not broad enough
   - Patient movement: slight movements of patient’s head can lead to poor alignment of laser spots; if there is gross movement, the laser stops immediately
Anterior Capsule Tears occur when there is 1) inadvertent tugging, aspiration or suction of an undetected capsular tag at the capsulotomy margin 2) excessive pressure on the edge of a jagged femtosecond laser capsulotomy eg. by the infusion/aspiration tip when removing subincisional cortex, cut-through by pull of iris hooks

In these scenarios, a posterior extension may occur leading to posterior capsule rupture and potential problems of nuclear drop and vitreous management.

Practical tips

• At the beginning, check completeness of the capsulotomy using eg. a sinskey hook or microforceps, to distract all around the margins of capsulotomy cut

• Applying the radial force centrally helps to release a tag

• For a bridge, try to tear circumferentially outside the original femtosecond capsulotomy path to encompass the area that had been left incompletely cut by the laser, thus avoiding a dog ear or a leading edge that may extend

  *Always stay alert:*

  • If there is a capsular tag/ bridge, try to stay away from these areas when doing irrigation/aspiration around the edge of the capsulotomy to avoid formation of an anterior capsule tear

If there is an anterior capsule tear, how to avoid a posterior extension?

• A bimanual system of irrigation & aspiration, may be preferred, as it can reduce stress to the anterior capsule during removal of subincisional cortex.
• Do gentle careful hydrodissection

• Slowly strip cortex from the anterior capsule towards the posterior

• Whenever instruments are removed from the eye, maintain the anterior chamber space by injecting viscoelastics

• Careful manipulation of fragments during phaco and avoid division of fragments in the vicinity of the tear

4. Hydrodissection

After femtosecond laser treatment of the nucleus, there are gas bubbles in the intralenticular space which already distend the capsular bag and increase intralenticular pressures. Normal hydrodissection can stress the capsular bag further and cause hydorupture of the posterior capsule with consequent nuclear drop. In general, deeper, longer and more cuts require higher energy, resulting in more gas production. In addition, faster lasers induce less gas production.

The “Pupil snap sign” of hydorupture of the posterior capsule as seen in regular phacoemulsification can also occur in FLACS.

Practical tips:
• If there are lots of gas bubbles, the surgeon can try to release pressure by pressing down on one side of the nucleus to burb out the gas

• Alternatively, controlled hydrodissection, with small aliquots of fluid can help to displace the gas bubbles anteriorly until they escape through one side of the capsulotomy
5. Femto-fragmentation patterns

Practical Tips:

• Radial cuts/segments
  o “Pie” cuts favor a chopping technique
  o Soft nuclei: Conventional 4-quadrant cut may be adequate. Use of a prechopper can be helpful to divide the quadrants
  o Increase the number of “pies”/segments as nuclear density increases

• Ring cuts (concentric circles)
  o Useful to soften the inner nucleus especially for harder cataracts

• Combination of radial segments and rings
  o For very hard cataracts, radial segments facilitate chopping and the rings further separate pieces of the denser inner nuclear core from the outer nuclear core, thus aiding efficient removal of these chopped fragments
  o Downside: For soft cataracts, addition of rings can hinder ability to chop segments properly due to inadequate “hold” because of disintegration of inner nucleus before chopping is performed

• Cubes fragmentation pattern
  o Not much chopping required and useful for one-handed surgeons
  o Can cut down effective phaco time by using high vacuum aspiration
  o Downside: cubes can fly around and get hidden: risk of retained fragments and secondary cornea edema

General Principles of Posterior Capsule Rupture (PCR) Management
If PCR is suspected during phacoemulsification (eg. sudden deepening of anterior chamber, loss of followability of fragments, difficulty hold-
ing on to fragment), stop phacoemulsification immediately, but do not remove instruments from eye until having injected dispersive viscoelastics through the side port whilst simultaneously stopping irrigation flow. Principle is to avoid vitreous prolapse into anterior chamber. Next step is to assess how much nucleus is left and decide how to safely maneuver nuclear pieces into anterior chamber for removal. Use triamcinolone to check for vitreous prolapse. Perform dissociated anterior vitrectomy (high cut rate, low aspiration settings) to clear it away and avoid traction on retina and communication with wounds.

6. **Irrigation and Aspiration (I/A)**

   - Rim of femtocapsulotomy can look white, due to high laser energy and the underlying laser-cut soft lens matter at trim tend to be more adherent/sticky
   - Sweep the opening of the I/A cannula side to side under the anterior capsule to free the adherent cortex and then aspirate it
   - Stay away from the very edge of the capsulotomy to avoid inadvertent catching of unseen capsular tag or bridge as this can lead to an anterior capsule rip

Some recent Publications for Femtocataract surgery


