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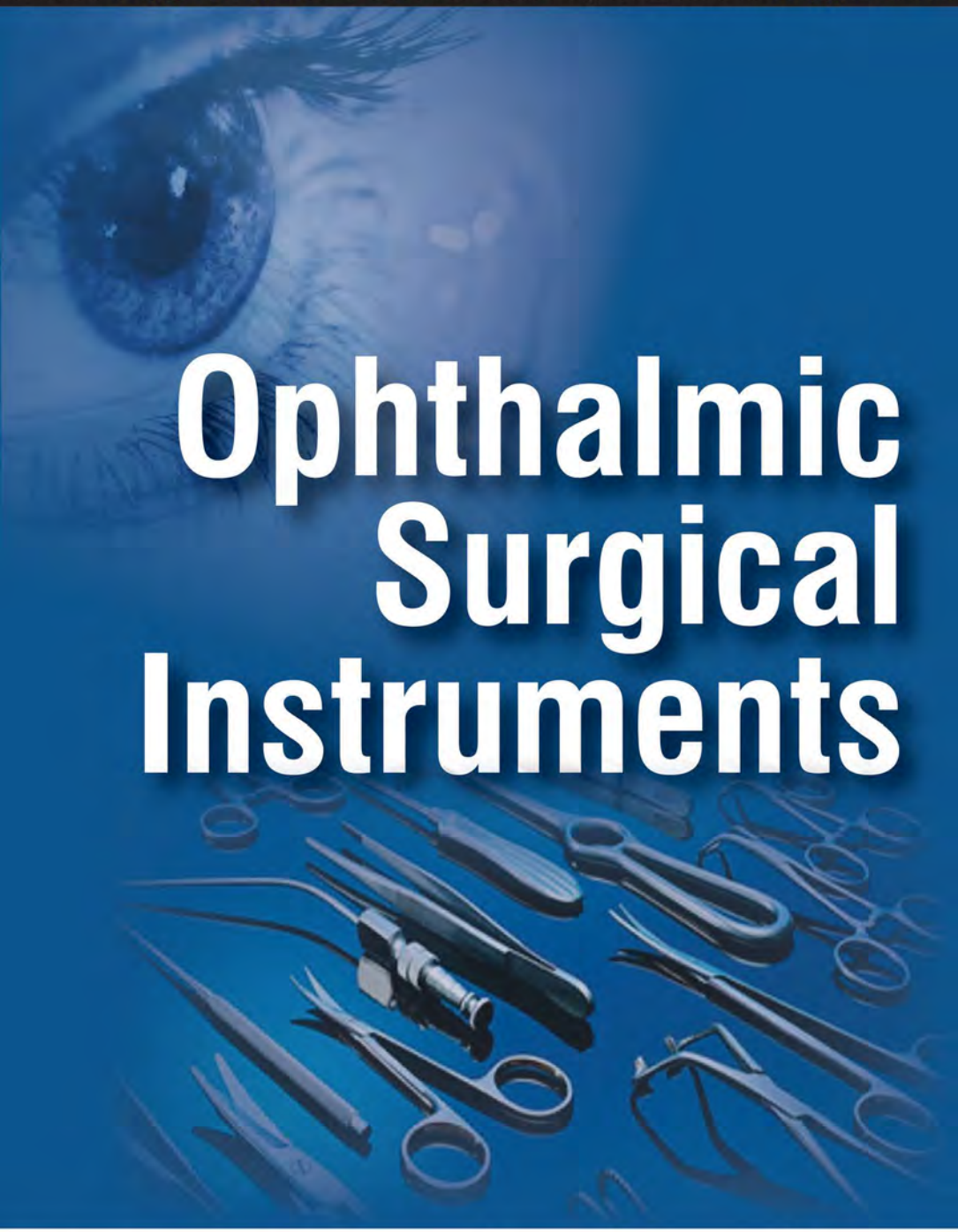

Ophthalmic Surgical Instruments

Rajesh Sinha
Jeewan S Titiyal
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Foreword
Amar Agarwal

JAYPEE

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2

Chapter

Instruments for Cataract Surgery

Manpreet Kaur, Roshan T, Jeewan S Titiyal

THERMAL BALL POINT CAUTERY

It is a heat cautery with a round copper ball for retaining the heat and blunt tapering ends for cauterization. The cautery is heated by holding the copper ball in the flame of the spirit lamp. The heat is transmitted to the tip which helps achieve hemostasis by thermal coagulation of the bleeding vessels. The handle is designed in a manner to prevent transmission of heat along its length to the surgeon's hand (Figure 1).

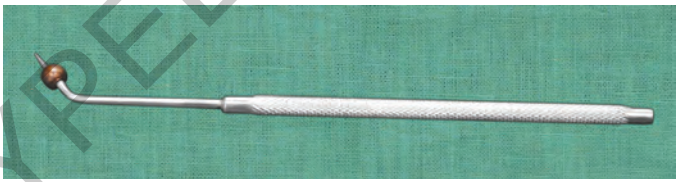

Figure 1: Thermal ball point cautery

Uses

It is used for thermocoagulation of small vessels. The vessels can be cauterized as close as 0.5 mm from the origin.

ELECTROCAUTERY

In an electrocautery, heat is generated through an electrical current and flows to a metal tip to coagulate blood vessels and stop bleeding.

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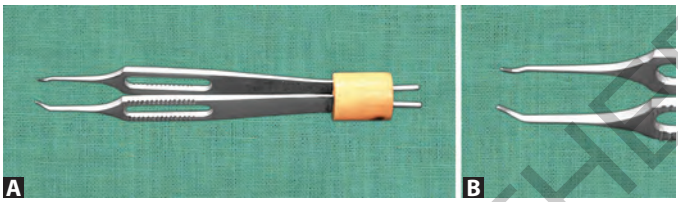
A bipolar electrocautery is used (Figure 2) in ophthalmic surgeries in which the current is passed between one forceps tip to the other and a limited amount of tissue is cauterized in between. Bipolar cautery allows for more precise delivery of the heat with minimal lateral thermal damage. It is also called wet field cautery as it is used in moist field.



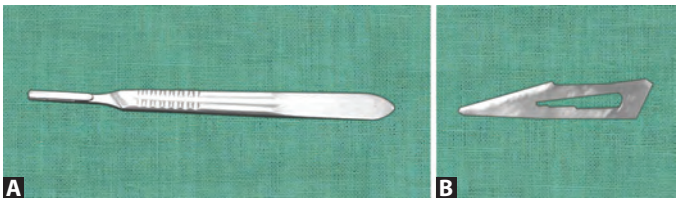
Figures 2A and B: Bipolar electrocautery

Uses

- Hemostasis
- Induce punctal stenosis for patients with dry eyes
- To appose the conjunctival flaps created during a peritomy
- As a surgical marker for toric reference axis marking.

BARD PARKER KNIFE HANDLE WITH BLADE

It is a surgical scalpel that consists of two parts, a blade and a handle (Figure 3). The handle is reusable, with the blades being replaceable. The handle is also known as a "BP handle", named after Charles Russell Bard and Morgan Parker. The handle may be flat or rounded, and may be compatible with a number of disposable stainless steel blades which are loaded in the groove. In ophthalmic surgery, No. 11, 12 and 15 blades are commonly used.



Figures 3A and B: Bard parker knife handle with blade

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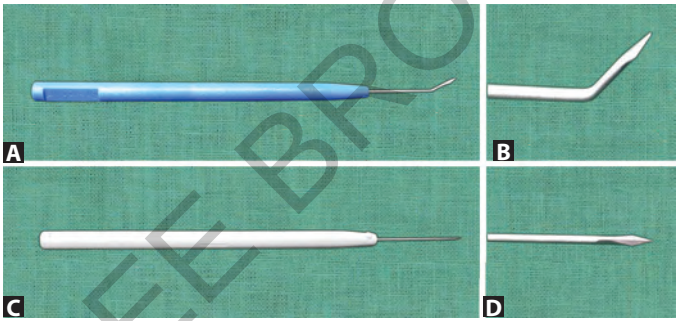
Uses

- To make a partial thickness corneoscleral incision in cataract surgery
- To make partial thickness scleral incisions while making scleral flaps in glaucoma surgery or during scleral fixation of IOL
- To make skin incisions in oculoplasty procedures such as DCR, ectropion etc.

MICROVITREORETINAL BLADE

Microvitreoretinal (MVR) blade is a lancet-shaped blade attached to a plastic handle. The MVR blade can be straight or angled (Figure 4). Various sizes of MVR are available for variable width of the stab incisions, such as 19 G, 20 G, 23 G and 25 G.



Figures 4A to D: Microvitreoretinal blades. (A and B) Angled; (C and D) Straight

Uses

- It is used to make precise and consistent limbal side port incisions. The side port incisions are self-sealing and are used to introduce cystotome, Sinskey hook or chopper during cataract surgery
- It may be used to create an incision in a dense fibrous plaque in the anterior or posterior lens capsule during cataract surgery
- A 20 gauge MVR is used to make scleral stab incisions for 20-gauge pars plana vitrectomy
- It may be used for induction of posterior vitreous detachment or peeling of the epiretinal membrane.

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SIDE PORT/STAB KNIVES

They are disposable knives mounted on a plastic handle. The sharp stainless steel surgical blade consists of only one cutting surface which is angled at 15°, 22.5°, 30° or 45° (Figure 5). The width of the incision is 0.9–1.0 mm.

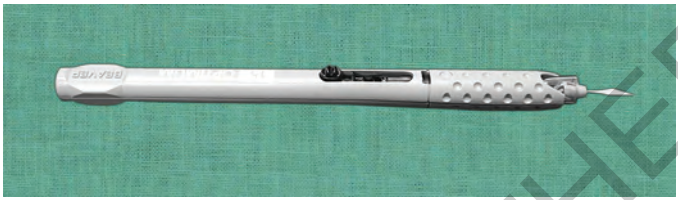


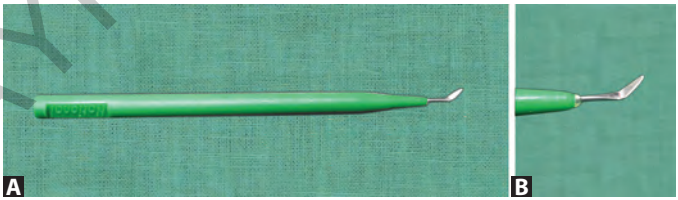
Figure 5: Side port/stab knives

Uses

- It is used to create a side-port limbal incision during cataract surgery
- It may be used to create an incision in a dense fibrous plaque in the anterior or posterior lens capsule during cataract surgery.

CRESCENT KNIFE

It has sharp edges with straight sides and rounded tip (Figure 6). The bevelled blade can be straight or at 45° angle to the handle which facilitates lamellar dissection and creation of tunnel incisions.



Figures 6A and B: Crescent knife

Uses

- It is used to make self sealing corneoscleral tunnel incisions in small-incision cataract surgery (SICS)

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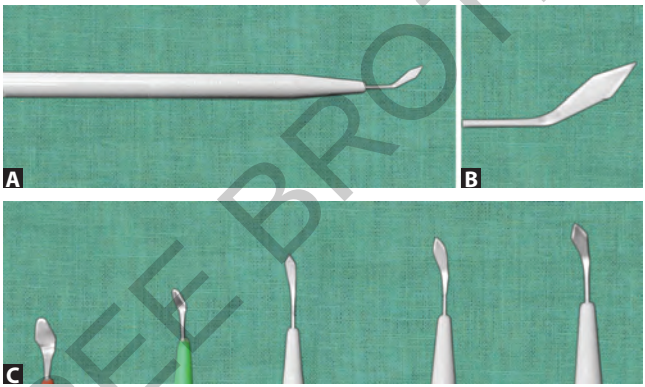
- To make partial thickness scleral flaps in glaucoma surgery or for scleral fixation of IOL
- Superficial lamellar dissection of the corneoscleral surface in pterygium surgery, limbal dermoid, etc.

KERATOME

A keratome has a thin diamond shape blade with an apex and cutting edges on both sides. The tip is sharp and pointed in keratomes used for making corneal incisions, and blunt in keratomes used to enlarge a corneal incision before implanting the IOL. The tip is made blunt to avoid secondary incisions. Keratomes are available with different angulations such as 15°, 30° and 45° and various widths such as 2.2 mm, 2.75 mm, 3.2 mm and 5.2 mm, etc (Figure 7).



Figures 7A to C: Various types of keratome

Uses

- It is used for making corneal incisions
- A 5.2 mm keratome may be used to enlarge the corneal incision before implantation of a rigid intraocular lens.

CYSTOTOME

A cystotome is a sharp tipped instrument with a bent shaft designed to help puncture the anterior capsule and allow manipulation of the resulting flap (Figure 8). Pre-bent cystotome needles are available (e.g. Mc Intyre 45° angled cystotome). Though commonly a cystotome is created from a 26 or 27 gauge needle by bending the

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needle tip down while holding the bevel up followed by bending the needle up near the hub. The angle of the bends are near 90° at the tip and slightly less at the hub. A third bend downwards in the middle of the needle can be made to provide more vertical displacement of the tip to aid in reaching down into deep anterior chambers. The cystotome is attached to a 1–2 cc syringe.

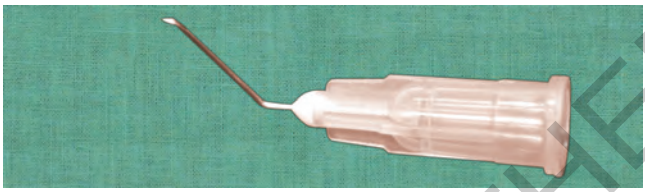

Figure 8: Cystotome

Uses

- To create an initial opening in the anterior capsule
- To create a continuous curvilinear capsulorhexis or a capsulotomy.

MICROCAPSULORHEXIS FORCEPS

The microcapsulorhexis forceps have a small diameter shaft that allows its use through a side port or phacoemulsification incision without stretching the incision or flattening the anterior chamber. The curved shaft allows easy access and comfortable hand position, even in deep set eyes. The squeeze handle provides delicate, tactile feedback and enables excellent tear control for capsulorhexis. The sharp tips can be used for the initiation as well as completion of capsulorhexis.

Uses

To create a continuous curvilinear capsulorhexis in microincision cataract surgery.

SMITH LENS EXPRESSOR (LENS HOOK)

This instrument has a flat metal handle, a rounded curve at the end and a knobbed tip (Figure 9).

The plane of the handle is at right angles to the curvature of the hook.

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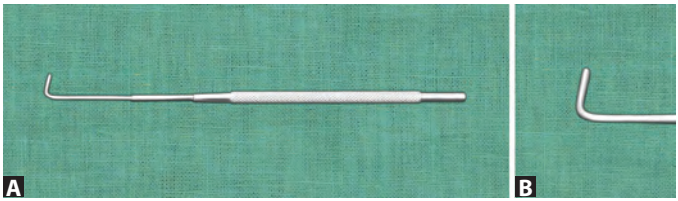

Figures 9A and B: Smith's lens expressor

Uses

- It is used for lens delivery in intracapsular cataract extraction
- It is used to help in nucleus delivery in extracapsular cataract extraction
- It can be used as a muscle hook in squint surgeries.

WIRE VECTIS

The wire vectis has a wire loop with a concave anterior configuration attached to a straight handle (Figure 10).

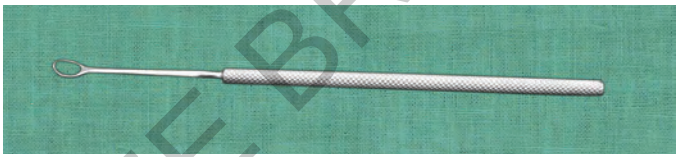

Figure 10: Wire vectis

Uses

It is used for expression of the nucleus in extracapsular cataract extraction and lens delivery in intracapsular cataract extraction. It is used to apply pressure on the sclera to depress the posterior lip of the wound and facilitate lens or nucleus delivery.

MCINTYRE IRRIGATING WIRE VECTIS

It is a modified wire vectis with a thick loop made of hollow wire. It has an anterior concave surface with three 0.3 mm openings. Posterior end of loop is continuous with hollow handle which is attached to syringe or infusion set. This assists in hydraulic separation of the nucleus and facilitates easy nucleus delivery by providing additional hydrostatic pressure. It has the additional advantage of maintaining

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the anterior chamber after delivery of the nucleus and minimizing the damage to the corneal endothelium (Figure 11).

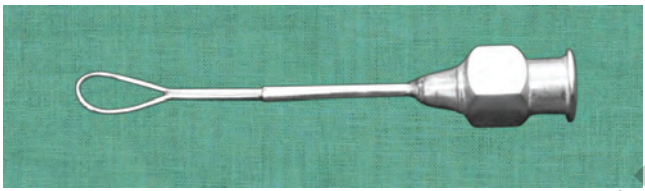

Figure 11: McIntyre irrigating wire vectis

Uses

- It is used for either hydroexpression or viscoexpression of the nucleus in extracapsular cataract extraction. The irrigating wire vectis is introduced from the corneal or corneoscleral tunnel and simultaneous counter pressure is applied at the 6 o'clock position using lens hook
- It is used for lens delivery in intracapsular cataract extraction.

SIMCOE IRRIGATION–ASPIRATION CANNULA

It has a straight or angular blunt cannula at one end and the other end has a main hub and a cannula which is attached to flexible silicon tubing (Figure 12). There are two designs of the Simcoe irrigation–aspiration cannula—the direct Simcoe and the reverse Simcoe cannula. The direct Simcoe has aspiration through the silicon tubing and irrigation through the main hub. An empty 5 cc syringe is attached to the silicon tubing for manual generation of suction by the surgeon for aspiration. The reverse Simcoe has aspiration through the main hub and irrigation through the silicon tubing.

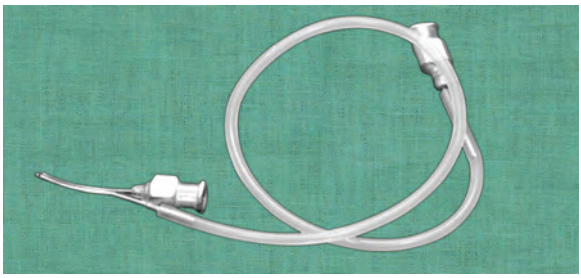

Figure 12: Simcoe irrigation–aspiration cannula

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Uses

- It is used for removal of the cortical debris or residual OVD while maintaining the anterior chamber depth during extracapsular and intracapsular cataract extraction
- It can also be used for anterior chamber wash or aspiration of hyphema.

J-SHAPED DOUBLE IRRIGATION–ASPIRATION CANNULA

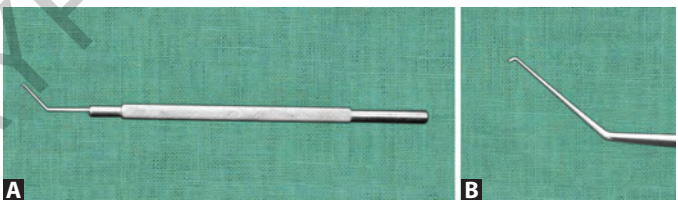
The cannula has a slightly curved shaft with an open ended top tip and a "J" shaped bottom tip with 0.3 mm side port. The 0.3 mm aspirating port faces into the J-shaped curve and the 0.3 mm irrigating tip is recessed 2.5 mm in the top tip. The tip diameter may be 20 G or 23 G.

Uses

- It is used for removal of the cortical debris or residual OVD while maintaining the anterior chamber during extracapsular and intracapsular cataract extraction.
- It can also be used for aspiration of hyphema.

SINSKEY HOOK

A Sinskey hook has a pencil like handle with a thin shaft and an angled tip (Figure 13). The shaft can be straight or bent at 45°. The angled tip is bent at 90° and is 0.18 mm in diameter.



Figures 13A and B: Sinskey hook

Uses

- Rotation of the nucleus and prolapsing it into the anterior chamber
- Lens dialing and manipulation. The tip is engaged in the hole present in optics of posterior chamber intraocular lens and is used to rotate it

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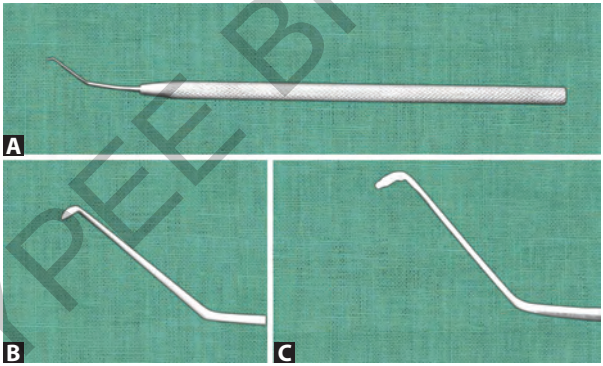
- Used as a second instrument through the side port during phacoemulsification to stabilize the globe
- During irrigation–aspiration: To prevent occlusion of the I/A probe with the cortical matter
- To release posterior synechiae
- Mechanical stretching of small rigid pupils
- Elongated Sinskey may also be used as a nucleus splitter.

CHOPPER

The instrument was first designed by Nagahara. A chopper consists of a handle and a distal portion with a tip that is 1–2 mm long and angled 90° (Figure 14). Various types of choppers are available. Blunt choppers have a rounded ball-shaped end with an internal cutting edge and are useful for horizontal splitting of the nucleus. Sharp choppers have a pointed tip with a sharp inner cutting edge and are useful for vertical splitting of the nucleus. An irrigating chopper is used in bimanual phacoemulsification.



Figures 14A to C: (A) Chopper; (B) Sharp chopper with pointed tip and sharp inner cutting edge; (C) Blunt chopper with rounded ball-shaped end and internal cutting edge

Uses

- A chopper is used through the side port opening for chopping and splitting the nucleus
- It allows manipulation and rotation of the nucleus during phacoemulsification

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- It helps to stabilize the globe
- An irrigating chopper allows dual functions of irrigation as well as splitting of nucleus in bimanual phacoemulsification.

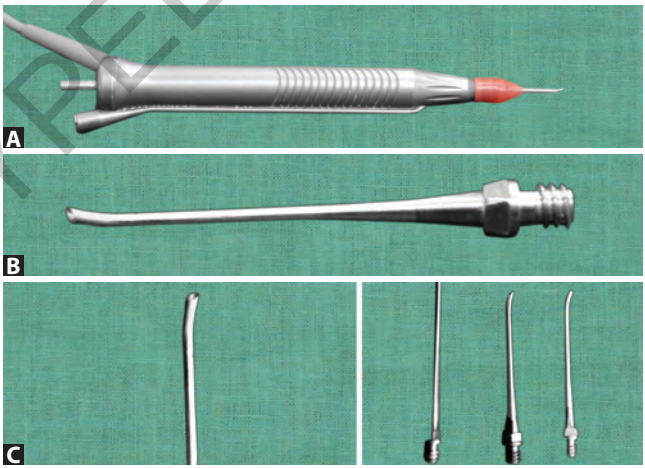
PHACOEMULSIFICATION PROBE AND TIPS

Phacoemulsification probes (Figure 15) are used for cutting and emulsifying the hard central nucleus and epinucleus. Different needle tips can be used with the phacoemulsification probes with different angulations (0° to 60°) of the bevelled opening at the tip.

Tips with greater angulation (e.g. 45°) produce a sharper cutting edge with a better sculpting ability. However, they are more difficult to occlude because of a larger surface area. Tip with lesser degree of angulation (e.g. 15°) is easy to occlude and has better holding power. A 30° tip provides a balance between cutting and occludability.

Most of the phacoemulsification tips are 3/4th of an inch long. The standard tip has a diameter of 1.1 mm and the microtip has a diameter of 0.9 mm and is designed for smaller corneal incisions.

The flared tips have narrow shanks and flare out at the tip. The widened tip creates power closer to the tip and acts as a power amplifier. The narrow shank creates a restriction to flow, rendering the chamber more stable. There is increased control and more power with these tips.



Figures 15A to C: (A) Phacoemulsification probe; (B) Kelman tip; (C) Phacoemulsification tips

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Kelman (bent) phacoemulsification tip has a 22.5° angle in the shaft located 3.5 mm from the tip. As the center of mass is located away from the motion axis, there is a transverse motion in addition to the longitudinal motion which results in more efficient emulsification of the nuclear fragments.

The Aspiration Bypass System (ABS) tip is a standard phacoemulsification tip with a 0.175 mm hole drilled in the shaft. During occlusion of the tip with nuclear material, the flow continues through the hole in the shaft which helps in prevention of surge.

INFUSION SLEEVES

Infusion sleeves (Figure 16) are made of silicon and surround the phacoemulsification needle tips and coaxial irrigation–aspiration hand pieces. The sleeve allows for irrigation around the tip, lowering the resulting temperature to avoid wound burns. Irrigation typically exits the sleeve from side ports. The sleeve can be adjusted to expose the amount of Phaco tip the surgeon desires. The sleeve can act as a barrier to tip penetration into lens material. Novice surgeons are often advised to minimize tip exposure, to provide a higher level of safety. When the phaco tip is held bevel up, the irrigation ports on the sleeve are frequently oriented horizontally, such that irrigation is aimed sideways and not directly at the corneal endothelium.

Infusion sleeves are available for 19 G, 20 G, 21 G and 23 G Phaco tips for incisions of 2.8 mm to sub 2.00 mm. A mismatch between the sleeve and incision size may result in anterior chamber instability if the incision is too large for the sleeve, or an increased risk of wound burn if the incision is too tight for the sleeve.

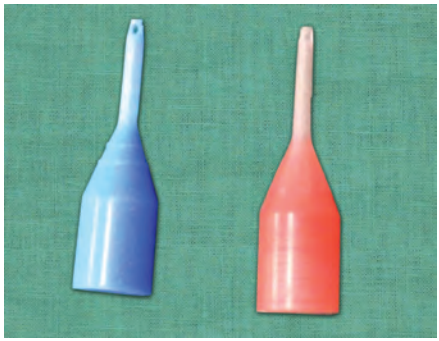

Figure 16: Infusion sleeves

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IRIS REPOSITOR

It is a smooth spatulated instrument with a rounded tip. The blade may be gently curved or angled with blunt edges (Figure 17).

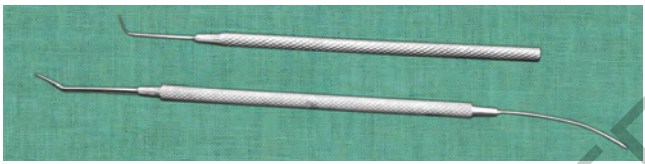


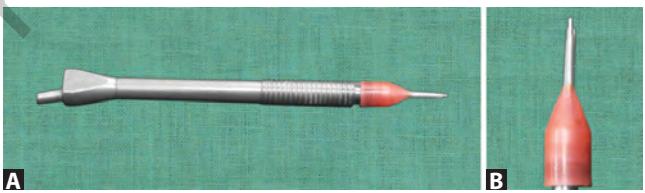
Figure 17: Iris repositor

Uses

- To gently reposit the iris in the anterior chamber in cases with iris prolapse
- To perform synechiolysis
- May be used to perform cyclodialysis.

COAXIAL IRRIGATION–ASPIRATION HANDPIECE

Coaxial irrigation-aspiration (I/A) hand piece (Figure 18) has the irrigation and aspiration ports located on a single handpiece. The handpiece sleeve can be composed of metal or newer silicone soft sleeves which provide better wound sealing and more stable anterior chamber maintenance. The tip can be straight, curved, angled up to 90° or J-shaped for ease of subinicisional cortex removal. Some tips have roughened surfaces or are made from silicone to allow for posterior capsular polishing. The aspiration port is generally 0.3 mm and the irrigation port is 0.8 mm.



Figures 18A and B: Coaxial irrigation–aspiration handpiece

Uses

- For irrigation–aspiration of the cortical matter and residual OVD during phacoemulsification
- To polish the posterior capsule.

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BIMANUAL IRRIGATION–ASPIRATION HANDPIECE

Bimanual I/A handpieces (Figure 19) have irrigation and aspiration ports on separate handpieces. The diameter is variable and 19 G, 21 G, 23 G and 25 G hand pieces are available.

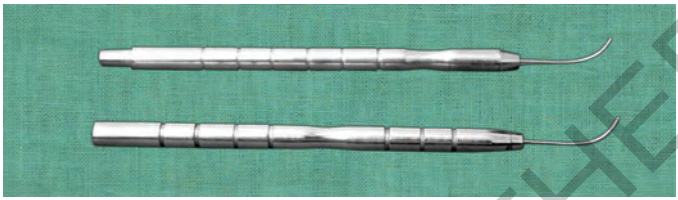

Figure 19: Bimanual irrigation–aspiration handpiece

Uses

- For irrigation–aspiration of the cortical matter and residual OVD during phacoemulsification. They are useful in bimanual phacoemulsification as the bimanual handpieces can be easily inserted through the side ports
- For removal of difficult subinicisional cortical matter
- To polish the posterior capsule.

CANNULA

The cannula are hollow needle-like instruments with a blunt or rounded tip, that are fitted to an irrigation line or an aspiration mechanism such as a syringe (Figure 20). The tip is angled at 45°. A 27 G cannula is commonly used.

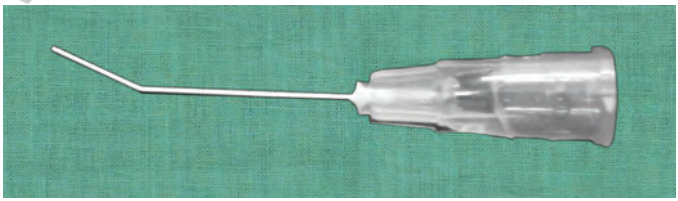

Figure 20: Cannula

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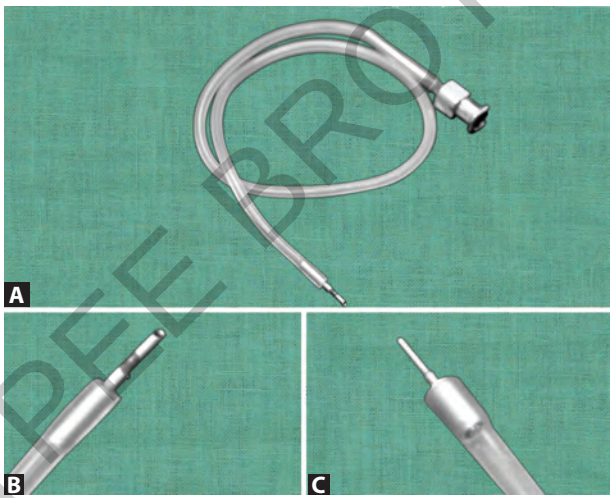
Uses

- To perform hydrodissection and hydrodelineation
- To irrigate the anterior chamber with balanced salt solution
- Injecting OVDs and various solutions such as trypan blue dye, pilocarpine, adrenaline and air, etc. in the anterior chamber.

ANTERIOR CHAMBER MAINTAINER

Anterior chamber maintainer has a bevelled tip at one end for inserting in the anterior chamber. The other end has a silicon tube that can be attached to the infusion line. The tip diameter may be 20 G, 23 G or 25 G. The tip may be threaded or smooth; a threaded tip makes the instrument self-retaining (Figure 21).



Figures 21A to C: (A) Anterior chamber (AC) maintainer; (B) Threaded tip 20 G AC maintainer: (C) Smooth tip 23 G AC maintainer

Uses

To maintain the stability of the anterior chamber during surgery.

VON GRAEFE KNIFE

It has a sharp straight blade attached to a stainless steel handle (Figure 22).

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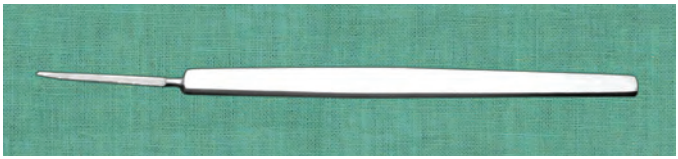

Figure 22: Von Graefe knife

Uses

To make an ab-interno incision of the cornea during intracapsular cataract extraction. An inside-out incision from 3 o'clock to 9 o'clock is made for delivering the lens.

ARRUGA CAPSULE FORCEPS

Arruga capsule forceps (Figure 23) have cupped tips with posterior apposition and a small gap anteriorly to prevent iris damage.



Figures 23A and B: Arruga capsule forceps

Uses

To hold the anterior lens capsule just anterior to the equator during intracapsular cataract extraction.

KIRBY LENS EXPRESSOR AND REPOSITORY

The instrument has a blunt, round tip angled at 90° at one end and an iris repositor with a smooth, blunt tip at the other end.

Uses

The angled tip is used to deliver the lens in intracapsular cataract extraction. The blunt smooth end is used to reposit the prolapsed iris.

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KIRBY LENS EXPRESSOR AND VECTIS

The instrument has a blunt, round tip angled at 90° at one end and a ring shaped loop at the other end.

Uses

- The angled tip is used to deliver the lens in intracapsular cataract extraction
- The wire vectis is useful in retrieving and delivering a subluxated lens or nucleus and preventing it from falling back in the vitreous.

LENS HOLDING FORCEPS

It is a spring action nontoothed forceps with blunt curved blades (Figure 24).

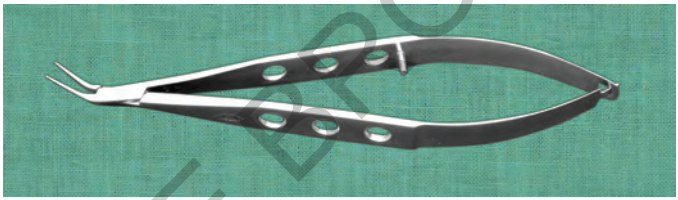

Figure 24: Lens holding forceps

Uses

It is used to hold the PMMA IOL during implantation.

LENS FOLDING FORCEPS

They are nontoothed forceps with direct or cross action tips.

Uses

They are used to fold and insert acrylic or silicon foldable IOL.

IOL INJECTOR

Plunger or screw style instruments with slot for insertion of cartridge loaded with foldable IOL (Figure 25). They can be reusable or

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disposable. Disposable injectors may be preloaded with the cartridge and IOL.

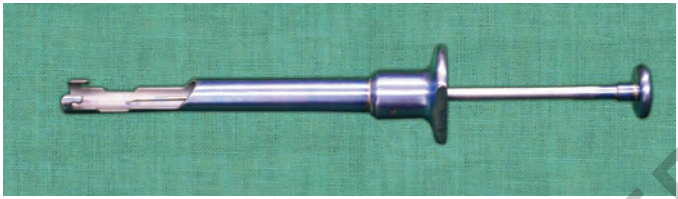

Figure 25: IOL injector

Uses

It is used to inject foldable intraocular lens loaded in cartridge in the bag.

AUTOSERT

It is an automated IOL injector and its movement is controlled by the foot pedal (Figure 26). A foldable IOL is placed in its cartridge, which is then loaded in the autosert. It has the advantage of precise surgeon control of intraocular lens (IOL) delivery with better wound integrity.

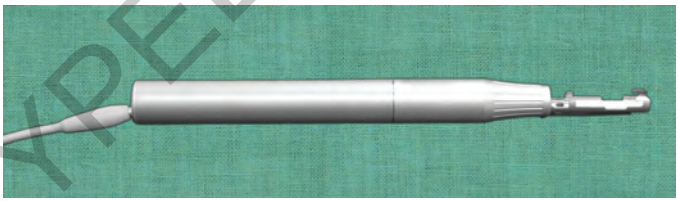

Figure 26: Autosert

Uses

It is used for automated controlled injection of foldable intraocular lens in the bag.

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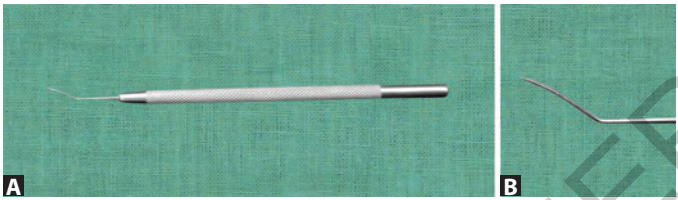
STEVENS FEMTOSECOND FLAP LIFTER

It has a thin curved blade with sharp edges and an angled curved shaft (Figure 27).



Figures 27A and B: Stevens femtosecond flap lifter

Uses

- To open primary and secondary femtosecond laser created corneal incisions in femtosecond laser assisted cataract surgery
- To raise the flap in femtosecond LASIK and release the adhesions under the flap.

KROKCHINGS FEMTO INCISION OPENING SPATULA

A double ended spatula with 4 mm slightly curved spatula blades, a 0.5 mm fine flat tip at one end and a 0.5 mm 90° angled tip with a fine point at the other end.

Uses

- The flat tip is used to open the primary and secondary corneal incisions
- The angled point is used to open the limbal relaxing incisions.

CIONNI FEMTO SPATULA AND NUCLEUS DIVIDER

The spatula has two ends. One end acts as a femto spatula and has a fine point with a 3 mm spatula blade; the other end acts as a nucleus divider and has a 1.6 mm × 0.8 mm blade (Figure 28).

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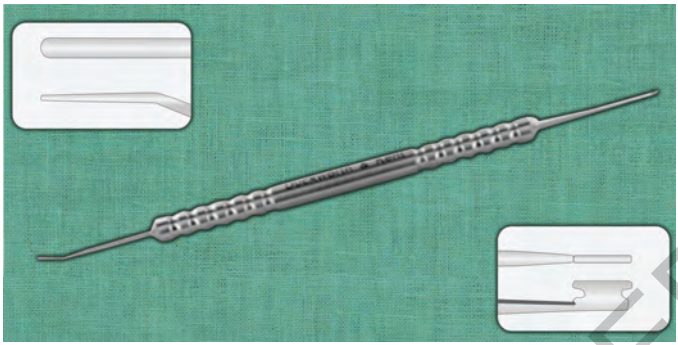

Figure 28: Cionni femto spatula and nucleus divider

Uses

The femto spatula opens primary and secondary femto created incisions and the nucleus divider is used for pushing and pulling the iris or anterior capsular edge.

DR RANA'S DOUBLE TOOTH PHACO CHOPPER

A Double toothed blunt tipped chopper (Figure 29).

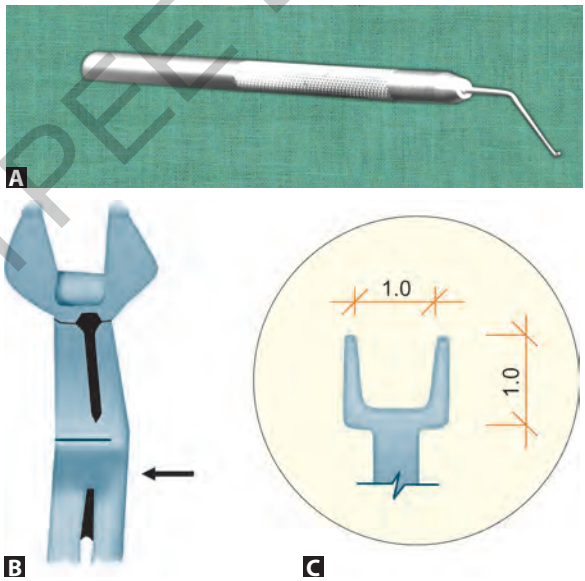

Figure 29: Tip of Rana's chopper

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Salient Features

- Two teeth at tip
- Tip is blunt

Advantage

Due to presence of double tip greater surface area of the nucleus is engaged and greater part of nucleus is trapped and the nucleus is stabilized so that chopping becomes easier.

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ISBN 978-93-86322-97-5