www.jmscr.igmpublication.org
Impact Factor 5.244
Index Copernicus Value: 83.27
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v4i10.95

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

# Surgical Technique of Manual SICS-A Review

Authors
**P.Ramya, S.Manavalan, P.Mishra, V.Sridevi, M.Ramya and G.Ramakrishnan**

**Abstract**
*Our aim is to describe and present the various steps involved in performing Manual SICS with special attention to the wound construction i.e the sclerocorneal tunnel. Wound construction plays a major role in MSICS and forms the backbone on which the successful completion of subsequent steps of capsulorrhexis, hydroprocedure and nucleus delivery depend on. The considerable handling inside the anterior chamber during nucleus delivery increase the chances of iris injury, striate keratitis, and posterior capsular rupture. Proper understanding of the various steps involved in the successful completion of MSICS can go a long way in preventing iatrogenic complications and achieving good visual outcomes.*
**Keywords:** *Sclerocorneal tunnel, Capsulorrhexis, Hydroprocedures, MSICS, IOL.*

## Introduction

In India, there are 12.5 million blind and it is estimated that 50% to 80% are due to cataract. An estimated 4 million people become blind because of cataract every year which is added to a backlog of 10 million operable cataracts in India, whereas only 5 million cataract surgeries are performed annually in the country. Due to continued improvement in surgical technique the incidence of complications of cataract surgery with intraocular lens implantation have decreased in recent years.

The main reason for low uptake of cataract surgery in developing countries is high cost.In this scenario MSICS with IOL is a hope because this technique is most cost effective to patients as well as doctors, less time consuming, so high volume surgeries are possible. The procedure is simple, safe and effective.

## Sclerocorneal Pocket Tunnel Incision

Wound construction is of vital importance in SICS. The ultimate outcome and the ease of delivering the nucleus are dependent on wound architecture. There are two aspects of the incision for SICS which we must consider. One is the self sealing nature of the wound, and the other is the induced astigmatism.

The properties of a reliable self-sealing incision are:

1. Square incisional geometry
2. Relatively short external incision with a tunnel that flares to a larger internal incision
3. Geometric external incision shape that lends itself to stretching[1,2.]

Square incisional geometry, which means the length of the tunnel must be equal to or exceed the width of the tunnel, is a guideline and not a strict rule for surgical planning. In the real world, self-sealing incisions only strive to approach the square configuration[29]

The scleral tunnel has six aspects: size (i.e., the length of the tunnel), shape (style), location, depth, width, and entry into the anterior chamber.

The scleral groove external incision is initiated by the Bard-Parker knife with number 15 blade. The external configuration of the incision is usually curvilinear but may be oriented straight when a small incision is being made. The anterior limit of the incision is 2–3 mm behind the limbus, and the length of the incision (which is the distance between the two ends, but not along the curvature) varies from 5 to 6mm for cortical cataract, and from 7 to 8 mm for nuclear sclerotic grade IV cataract. In case of a compromised corneal endothelium, larger incision size would be warranted to facilitate the easy delivery of the nucleus without too much manipulation in the anterior chamber. This should be coupled with adequate use of a dispersive viscoelastic substance.

The primary deciding factor in the length of the incision is always the grade of cataract as well as size of nucleus and not the size of the intraocular lens (IOL) to be implanted[3].

For instance, if we expect the size of the nucleus to be bigger than the 6.0 mm optic size of the lens to be implanted, we would make a bigger incision to accommodate the nucleus of that size and not a small incision to accommodate the optic size. The incision has to, however, allow the optic diameter to pass through it easily without traumatizing the tunnel created. The width of the tunnel is the distance between the external scleral incision and the internal corneal entry incision, which should be at least 4 mm in size[27]. The external configuration may either be straight or curved. Paul Koch described the “Incisional Funnel” indicating the astigmatic neutral zone[4].The frown incision is hence best suited for MSICS[28]. The tendency of wound-edge separation is also less for this configuration[5.]

The scleral flap should neither be too thick nor be too thin. A thin flap has a tendency to tear or give way to superior button-hole formation[5].To overcome this unfortunate complication, if the button-hole is on one side, then the other end is dissected further to confirm with the same incision. If the button-hole is in the center, the original site is abandoned and another area is chosen or dissection is carried out at a deeper plane in the same area. A thick flap usually does not cause any problem unless the scleral spur or ciliary body is damaged.

Optimal incision depth is usually one-half to two thirds the thickness of the sclera or about 0.3 mm[5].

The pocket tunnel is dissected with a diamond or metal crescent disposable knife at the bottom of the 0.3-mm deep external cut, and it is propagated anteriorly until it engages the limbal tissue. It should be remembered that the eyeball is a globe and the crescent has to orient in an upward and forward direction to remain parallel to the sclera. Cornea is steeper than the sclera, and therefore, tunnel dissection should be slightly anteriorly directed in the cornea after crossing the limbal area. The limbal tissue resists dissection more than the sclera or corneal tissue. To overcome this extra resistance, care must be taken not to engage extra forward cutting movement, as this might cause uncontrolled forward corneal dissection after overcoming the sudden resistance during the dissection of the limbus and thus result in a premature entry into the anterior chamber or out of the cornea. As the dissection approaches the lateral end of the tunnel, the knife is tilted sideways while dissection is continued, creating a funnel-shaped tunnel of about 45 degrees. Thus, the internal aspect of the tunnel would be about 25% larger than the external incision. The crescent blade should be cutting while being brought out of the tissue. The pocket tunnel dissection is carried forward 1 mm into the clear cornea in front of the vascular arcade.

After the construction of the tunnel, the crescent is withdrawn, and the microkeratome is introduced into the tunnel in an oscillating movement right and left to avoid premature perforation into the anterior chamber, until the tip of the keratome reaches the end zone of the tunnel dissected. Then, the keratome is tilted downwards to enable perforation into the anterior chamber. After entering the anterior chamber, the keratome is moved laterally and forward causing the internal incision to direct itself in a curved fashion parallel to the limbus. The direction of movement of the keratome should be lateral and anterior and not lateral and posterior. By moving posteriorly, the internal opening will move towards the limbus, and valve action will be lost leading to leakage.

**Temporal**

The temporal location is farthest from the visual axis, and any flattening due to wound is less likely to affect the corneal curvature at the visual axis. When incision is located superiorly, both gravity and eyelid blink tend to create a drag on the incision. These forces are better neutralized with temporal incision because it is parallel to the vector of the forces. With the rule astigmatism induced by a temporal incision is advantageous because most elderly patients have preoperative against-the-rule astigmatism[6,7,8].Superior temporal incision also is free from effect of gravity and eye lid pressure and tends to induce less astigmatism[8].

**Capsular Opening**

Three types of capsular openings are commonly used – curvilinear capsulorrhexis, can opener capsulotomy and the envelope capsulotomy.

Capsulorrhexis is a controlled tearing of the anterior capsule producing a strong smooth regular and circular opening[9]. If one is using a capsulorrhexis, it should be of a fairly large size (6-6.5 mm) to allow the nucleus to prolapse into the AC. Relaxing cuts (2-4 in number) should be given at the rhexis margins if one feels that the opening may pose a problem to smooth nucleus prolapse. Use of dye in cases where the red reflex is inadequate allows safe completion of the capsulorrhexis.

A can opener capsulotomy as practiced for conventional extracapsular cataract surgery works well for SICS also.

However, an envelope capsulotomy is preferred as it is easy in all cataracts, and allows many of the benefits of capsulorrhexis.

**Hydroprocedures**

Hydroprocedures were first described by Michael Blumenthal[9], the originator of the mini-nuc technique of SICS. Faust coined the term hydrodissection.

**Hydrodissection** refers to the almost complete dissection of the corticonuclear mass from the lens capsule with the mechanical help of a fluid wave produced by injecting BSS or Ringer's lactate exactly in between the anterior capsule and the cortex[9].

The cannula is introduced either from the side port (preferable) or the main incision. The tip is guided about 1 mm behind the rhexis margin in the subcapsular plane at 12 o'clock and a small amount of fluid injected with a jerk to produce a fluid wave after slightly tenting the capsule.

Visual confirmation of the wave and a shallowing of the AC indicate the dissection. A gentle tap on the nucleus completes the hydrodissection and deepens the AC. The nucleus is gently rotated with the cannula both clockwise and anti-clockwise. Free rotation signifies successful hydrodissection.

**Hydrodelineation,** also known as hydrodelamination and hydrodemarcation, refers to the separation of epinucleus from the nucleus by a fluid wave between the two, with the aim of debulking the nucleus.

The cannula is introduced into the cortex and nucleus till it is posterior to the central hard core of the nucleus, or till it meets resistance where the soft outer nucleus ends. A small amount of fluid is injected in a jerky pulsed dose. This gives rise to a golden ring under the microscope, as fluid goes around the nucleus.

**Figure 1:** Mature Cataract Right Eye (Pre OP**)**

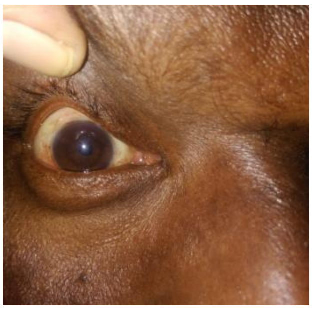

**Figure 2:** Pseudophakia Left Eye (Post OP)

**Nucleus Management**

**Nucleus prolapse through can-opener capsulotomy:** Following a can-opener capsulotomy, the nucleus can be prolapsed mechanically without any of the hydro procedures.

The Sinskey hook or the lens dialer is used for performing this step. The hook is introduced through the scleral tunnel, and after gentle retraction of the pupillary border of iris, the hook is embedded in the substance of nucleus at the edge of the equator or slightly posterior to it at the 12 o. clock position. The nucleus is then pushed down towards 6 o. clock position till the superior equator of the nucleus clears the pupillary margin. At this point, the nucleus is lifted up and rotated so that the superior pole of the nucleus gets prolapsed over the iris. Once one part of the nucleus is out, it is engaged with the Sinskey hook and rotated either in a clockwise or in an anticlockwise direction, until the whole nucleus is in the anterior chamber. Some surgeons find it easier to engage the nucleus at the 9.oclock position to perform the step described above. In patients with white cataracts, the loose and fluffy superficial cortex is aspirated exposing the firm nucleus underneath before prolapsing it mechanically with the Sinskey hook.

**Nucleus prolapse through capsulorrhexis:** Prolapsing the nucleus into anterior chamber after capsulorrhexis using fluid (hydroprolapsing method) is a vital step. Normally hydrodissection or fluid injection underneath the capsule breaks the adhesions between cortex and capsule[10]. Here, we use the same step to increase the hydrostatic pressure within the bag without putting any stress on the zonules to prolapsed the nucleus[11].First prerequisite is an adequate-sized capsulorrhexis. The margin of the rhexis is highly elastic and can allow safe expression of nucleus, which is larger than the opening[12,13,14]. Hydroprolapsing method is safe when the diameter of the capsulorrhexis is 5 mm or more[15,16]. Getting a right-sized capsulorrhexis is crucial, and its significance in MSICS cannot be overemphasized. With smaller or incomplete capsulorrhexis, it is safer to make a few relaxing cuts and proceed as described under can-opener capsulotomy. If one is experienced and skill permits, one can go in for a double capsulorrhexis. The second prerequisite is to have a soft eye. Overfilling the anterior chamber with viscoelastic increases the resistance to nucleus prolapse. Partially emptying the anterior chamber of viscoelastic by pressing the floor of the incision with the shaft of the cannula will permit the nucleus to easily prolapse.

**Nucleus Delivery**

The nucleus may then be delivered by any of the following techniques:

a. Nucleus delivery using an irrigating vectis[18,19,20,21],or a curved cystitome-the fish hook[22]
b. Using two instruments to sandwich the nucleus between them[23,24,25]
c. Bisecting the nucleus into two using two instrument, one as the "cutter" and another, usually a vectis, as the board[23,26]
d. By using a snare similar to the tonsillar snare[23]

e. Dividing the nucleus into three parts (trisection) using a triangular instrument and a vectis[23]
f. Using an anterior chamber maintainer and a Sheet's glide (the Blumenthal technique) [23]
g. Viscoexpression of nucleus.
h. Microvectis,3-4mm in size is introduced under the nucleus following which the nucleus is expressed by applying forward pressure gently. Minimal amount of depression of the posterior lip of the wound is done by shaft of the vectis[17].

**Epinuclear and Cortical Removal**

Epinucleus remaining after the nuclear removal can either be expressed with the same techniques used for nucleus expression (hydro-, visco-expression) or it may be aspirated with manual or automated aspiration. Cortical removal is by automated aspiration or manual aspiration by Simcoe cannula.

After having removed visible cortex, the posterior capsule may be polished with a sand blasted olive tip polisher or a scratcher. In the presence of a posterior capsular tear, ideal technique is the dry technique under viscoelastic.

**IOL Implantation**

The most commonly implanted IOL after SICS is the rigid 6-6.5 mm optic sized IOL.

The IOL of the correct power is held longitudinally by the forceps and manipulated through the tunnel into the AC. The IOL is held tilted upwards at the time the leading haptic is being introduced into the tunnel. As the haptic enters the AC, the lens is made horizontal and gently pushed inside. Once the leading haptic reaches the 6 o'clock margin of the capsulorr-hexis, the IOL is tilted slightly downwards to make the leading haptic pass under the rhexis margin. This can be done by lifting the trailing haptic. When the leading haptic is in the bag and the IOL is in the tunnel, the IOL is released and the forceps withdrawn. A Sinskey hook or a lens manipulator is used to maneuver the IOL into the bag.

**Wound Closure**

No suture is required to close the incision if the tunnel has been well fashioned and is of 5.5 mm to 6.5 mm in size. The side ports are hydrosealed. The conjunctiva is apposed over the wound with a bipolar cautery or by simply drawing it over the wound. If a suture is required, an infinity '∞' suture is applied.

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