Review Article

Complications of manual small-incision cataract surgery

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The manual small-incision cataract surgery (MSICS) is instrumental in tackling cataract-induced blindness in developing countries, especially with a sizeable proportion being hard brunescent cataracts. MSICS has a unique set of complications related to wound construction, the creation of the capsular opening, and the technique of nuclear delivery. A poorly constructed sclero-corneal tunnel or a small capsulorhexis hampers the nuclear extraction, and the extensive intracameral maneuvers increase the chances of postoperative corneal edema and iritis. Though MSICS has been shown to have universal applicability, producing replicable visual outcomes requires a significant learning curve. This article reviews the relevant published literature on complications of MSICS utilizing the databases of PubMed, Medline, Cochrane, and Google Scholar.

Key words: Complications, intraoperative, MSICS, postoperative

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Cataract continues to be the most significant cause of blindness in the population over 50 years of age in India.[1] Given the slowing down of surgeries in the last 2 years, the cataract backlog has further increased, and the Indian government has proposed an increase in the number of cataract surgeries from 75 lakhs in 2022–23 to 105 lakhs in 2024–25.[2] The modern-day cataract surgeries comprise phacoemulsification (PE) and manual small-incision cataract surgery (MSICS). In the setting of advanced cataracts and lack of universal availability of PE equipment, MSICS forms the backbone of community health services in India and other developing nations.[3] MSICS is the most performed procedure during cataract surgical training in India.[4] Even in the United States, recognizing its safety in very dense cataracts, MSICS has been incorporated into the residency training programs.[5]

Recent literature shows comparable outcomes and complication rates of PE and MSICS. These predictable results however are achievable only after a significant learning curve.[6]

In a study, from South India, higher complication rates were observed in PE (4.8%) than MSICS (1.46%) amongst ophthalmic trainees.[7] Another contemporary study from South India from a different institute showed complication rates of 15.1% (79/522) in MSICS and 7.1% (36/507) in PE during the learning phase.[8]

The nucleus delivery in MSICS is performed by a variety of techniques such as hydroexpression and viscoexpression,[9] microvectis technique,[10] sandwich technique,[11] modified fish hook technique,[12] using anterior chamber maintainer (ACM),[13] irrigating cannula,[14] manual phacofracture,[15] nucleus trisection,[16] nuclear snare technique,[17] and Sinskey hook method.[18] These methods have their own set of complications and warrant judicious selection in special situations.

This review covers the causes and prevention of surgical complications encountered during various steps of MSICS. It will also discuss the choice of nuclear delivery techniques in some special situations.

Anesthesia

The technique of MSICS involves considerable handling of conjunctiva, sclera, and iris. Consequently, peribulbar anesthesia continues to be the commonest mode of anesthesia for MSICS.[19,20] Experienced MSICS surgeons have, however, reported satisfactory results with topical anesthesia alone or in combination with intracameral lignocaine.[20,21]

The anterior subconjunctival anesthesia (ASCA) and subtenon anesthesia (STA) have also been explored for MSICS. These forms of anesthesia caused chemosis in 100% (77 of 77) and 17.1% (14 of 79) of cases of the ASCA group and STA group, respectively. The other minor event observed was subconjunctival hemorrhage in 24.4% (20 of 77) of ASCA and 10.9% (9 of 79) cases of the STA group.[22] A rare, reported complication of STA is serous choroidal detachment of the posterior pole in a patient on angiotensin-converting enzyme inhibitors following aggravation of angioedema.[23]

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Perioperative Complications

Wound-related complications

An appropriately constructed sclero-corneal tunnel is critical for the successful outcome of MSICS. After conjunctival peritomy, minimal cauterization should be performed, to avoid conjunctival/corneal burns [Fig. 1a], scleral necrosis, and astigmatism. A triplanar wound is then created consisting of an external scleral incision 1–2 mm from the limbus, a tunnel with side pockets, and an internal incision 1–2 mm from the limbus. The external incision is usually kept at 0.3–0.5 mm depth. A superficially dissected tunnel may end up in buttonholing of its roof and would require changing the plane to a deeper level. Too deep an incision can cause premature entry or scleral disinsertion.[24] A premature entry traumatizes the iris base and can cause iris prolapse, iridodialysis, and hyphema.[25] The iris prolapse blocks the nuclear egress and hampers cortical aspiration and intraocular lens (IOL) implantation. An excessive force with a blunt crescent was reported to cause buttonholing in 8.2% (28/339) and premature entry in 3.8% (13/339) of cases. The tri-planar configuration was maintained in all these cases but two eyes with premature entry had to be sutured.[26]

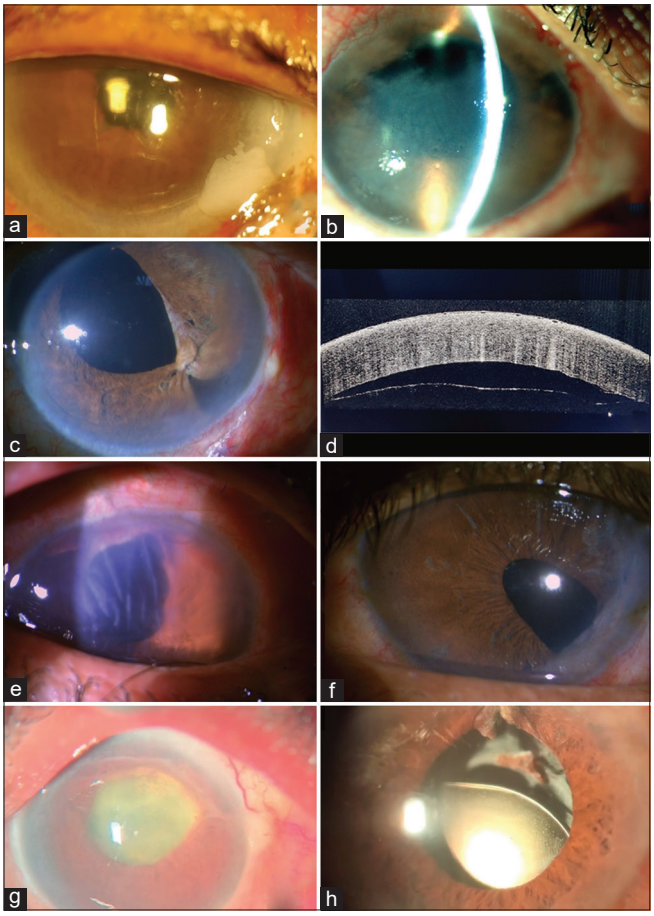

Figure 1: (a) Corneal burn in temporal MSICS due to excessive cauterization. (b) Clinical image showing Descemet's detachment in the inferior two-thirds of the cornea. (c) Repaired iridodialysis in temporal MSICS. (d) Anterior segment OCT showing Descemet's detachment. (e) Early corneal edema. (f) Peaked pupil due to iris incarceration in the temporal MSICS. (g) Postoperative endophthalmitis. (h) Decentration of the intraocular lens due to inferior zonular dialysis

A direct incision through the conjunctiva, tenons, and sclera was suggested to decrease the total surgical time. This modification caused a marginally higher rate of buttonholing 3.63% (4/110) and premature entry 2.72% (3/110) in comparison to separate dissection of the conjunctiva and sclero-corneal tunnel, which had two cases each of buttonholing and premature entry.[27]

Any breach in the wound integrity causes wound leak and increases the risk of endophthalmitis against the wound astigmatism.[24,25] Wound leak was the commonest reported intraoperative adverse event (33%) faced by trainees in the initial 10 cases of MSICS. The study recommended a low threshold for suturing the wound with questionable integrity and emphasized the need for practicing wound construction in wet labs during the training period.[28]

Descemet's detachment (DD)

An incorrect direction of keratome, inadvertent shallowing of the anterior chamber, or a bent tip of the blade can cause DD while entering the anterior chamber [Fig. 1b and d]. Forcibly pushing an IOL or cannula through a tight wound may also cause DD. The extension of a small DD can be curtailed by keeping a safe distance during the subsequent maneuvers from the site of DD, maintaining the anterior chamber depth, and leaving a large air bubble in the anterior chamber at the conclusion of the surgery. A large DD would require unscrolling followed by descemetopexy using 20% sulfur hexafluoride, 14% perfluoropropane, or suturing.[29] The reported rates of DD in MSICS vary from 0%,[30] 0.009% (3/31674),[7] 0.4% (4/1087),[31] 1.16% (8/689),[32] to 1.34% (7/522).[8]

Extension of continuous curvilinear capsulorhexis

An adequately sized capsular opening is desirable for nuclear prolapse into the anterior chamber. Nuclear manipulation through a small capsular opening can result in zonular dialysis (ZD). An enlargement of the capsulorhexis is recommended at this stage. Though MSICS can be performed with can-opener capsulotomy, capsulorhexis is desirable as it prevents inadvertent pull on the capsular tags during the cortical aspiration, an extension of the tear to the posterior capsule, better centration of the posterior chamber intraocular lens (PCIOL), and serves a scaffold for sulcus fixation in the case of posterior capsular rupture (PCR).[24]

Radialization of capsulorhexis may occur in hypermature cataracts due to raised intralenticular pressure. Subudhi *et al*. reported an extension of anterior capsular tear in 2.3% (8/339) of cases performed by residents, due to shallowing of the anterior chamber or excessive egress of viscoelastic on opening the tunnel. In seven of these, the nucleus could be prolapsed after slow cortical cleaving hydrodissection, whereas in one case, there was a posterior extension of the tear.[26]

Iris prolapse and iridodialysis

A pre-existing floppy iris, premature entry, or raised intraocular pressure (IOP) can cause iris prolapse. Iris prolapse was observed in 10.6% (36/339) of the resident cases[26] and in 3.5% (21/689) of staff-operated cases.[32] Repeated maneuvers to reposit the iris, trauma with Sinskey's hook while prolapsing the nucleus out of the capsular bag, and iris incarceration between the nucleus and the sclero-corneal tunnel can result in iridodialysis near the main wound [Fig. 1c]. Accidental

entrapment of the iris between the nucleus and microvectis can cause iridodialysis 180° away from the main wound in the microvectis, phacosandwich, and phacofracture techniques. Higher rates of iridodialysis were seen in MSICS in comparison to PE.[7,30] The reported rates of iridodialysis in MSICS are nil,[8] 0.03% (10/31674),[7] 0.5% (5/1087),[31] 0.73% (5/689),[32] and 6.6% (2/30).[30]

Zonular dialysis (ZD)

Pre-existing weak zonules, small capsulorhexis, entrapment of fluid between the nucleus and posterior capsule during hydrodissection, excessive use of force while prolapsing the nucleus into the anterior chamber or intraocular lens (IOL) implantation and inadvertent aspiration of the capsular edge can lead to ZD in MSICS. If the capsulorhexis margin is intact and visible, small dialysis can be managed by a capsular tension ring (CTR). If the dialysis exceeds 3 clock hours a modified CTR, capsular tension segment, haptic fixation, or secondary IOL would be required depending on the extent of dialysis.[24]

The published literature shows nearly comparable rates of ZD in MSICS and PE, 3.8% (20/522) vs 1.4% (7/507),[8] 0.58% (4/689) vs 0.34% (2/592)[32] and 0.08%(27/31674) vs 0.13% (26/19337),[7] respectively.

The presence of zonular fragility in pseudoexfoliation syndrome was found to increase the risk of lens dislocation and ZD with MSICS.[33] Gentle handling of mature and brunescent cataracts with pseudoexfoliation syndrome was recommended to avoid capsular complications.[34]

Posterior capsular rupture (PCR) and Dropped nucleus

MSICS is often used for high-volume surgery with comparable PCR rates among surgeons performing >72 MSICS per day with those performing <30 MSICS per day.[35]

PCR commonly occurs during cortical clean-up, accidental pull on the anterior capsular tag, or capsular polishing.[30,36] In brunescent and black cataracts, the creation of a large capsulorhexis allowed minimum manipulation of the nucleus and brought down the PCR rates to 1.96% (2/102).[37]

The closed chamber technique in MSICS causes minimal vitreous loss unlike conventional extracapsular cataract extraction (ECCE).[25] In the event of vitreous loss, automated vitrectomy is performed and PCIOL is implanted in the bag or the sulcus depending upon the size of PCR. In cases with large PCR and escaped capsulorhexis, secondary IOL implantation may be required. Suturing the main wound is recommended following a vitrectomy. In settings where automated vitrectomy was not available for the management of PCR with vitreous prolapse in MSICS, the odds ratio (OR) of getting poor best-corrected visual acuity (BCVA) (<6/60) was increased 19.3 times (95% confidence interval [CI]: 5.99–62.39, $P = 0.0001$).[38]

In the comparison of PCR rates between PE and MSICS, variability in data was observed. The reported PCR rates of PE vs. MSICS being 3.5% (7/199) vs. 6%(12/201),[39] 4.3% (18/417) vs. 6.5% (29/445),[32] 13% (4/30) vs. 6.6% (2/30),[30] 0.5% (159/31674) vs. 0.65% (126/19337),[7] and 4.3% (22/507) vs. 6.9% (36/522).[8]

Nucleus drop is rarely seen in MSICS. The preoperative characteristics associated with dropped nuclei include older age, diabetes mellitus, posterior polar cataracts, loose zonules, and posterior polar cataracts.[40] A higher risk of the dropped nucleus was found with PE in comparison to MSICS.[7] However, a recent report from the same hospital, following adjustment of the OR, failed to corroborate the previous findings.[40]

Suprachoroidal hemorrhage

The risk factors for suprachoroidal hemorrhage in MSICS are long axial length, high IOP, vitreous loss, hypertension, arteriosclerosis, and the use of anticoagulants. The suprachoroidal hemorrhage has not been reported with MSICS in the majority of the studies. Kamonporn *et al*. observed suprachoroidal hemorrhage in 0.15% (1/689) of eyes undergoing MSICS.[32] At the earliest suspicion of its occurrence, rapid closure of the wound, tamponades the bleeding and limits the damage.

Hyphema

Tunnel bleed may occur due to the trickling of blood into the anterior chamber from the section in a hypotonous eye. Bleeding at the external incision is managed by cauterization of the bleeder and sealing the main wound by side port hydration to push the internal flap against the outer flap of the sclerocorneal tunnel. A higher incidence of hyphema, 34% (22/66) was reported from deep (0.27 mm) tunnel and scleral pocket incisions, as compared to 6% (4/63) with a superficial incision blade setting at 0.17 mm for PE.[41]

Injury to the iris root or IOL haptic-induced chaffing of uveal tissue may lead to microbleeds. If the bleeder is identified intraoperatively, anterior chamber formation with a large air bubble, and suturing of the wound is recommended. Minimal hyphema noted in 6.20% (8/129) and 5.5% (11/200) cases were seen to resolve spontaneously within a week.[42,43]

Corneal edema

Transient corneal edema lasting for less than a week was observed in various studies, mostly during the learning phase [Fig. 1e].[10,16,39,44,45] Nucleus delivery techniques involving considerable manipulation in the anterior chamber such as phacosandwich, phacofracture, and trisection require a repeated injection of ophthalmic viscosurgical devices (OVD) to safeguard the endothelium.

Iritis

Any touch to the iris with the nucleus or an instrument, especially in the floppy iris, presence of synechiae, non-dilating pupil, or small capsular opening results in iritis. A higher incidence and severity of iritis were seen in the phacosandwich technique (16/20) due to a greater contact of instruments with the iris in comparison to Blumenthal's technique (2/40).[43]

Irregular pupil

The pupil abnormalities following MSICS may occur due to iris trauma, capsular tag, hyphema, vitreous in the anterior chamber, atonic pupil, inadvertent iris tuck with an IOL, and synechiae formation [Fig. 1f]. In a retrospective study of the resident who performed uncomplicated surgeries, 1.17% (4/339) had an updrawn pupil on the first postoperative day, two of which required re-surgery.[26]

Endophthalmitis

The sclero-corneal tunnel in MSICS varies in length from 3.0 mm to 8.5 mm. A larger wound may allow greater intracameral contamination with pathogenic organisms [Fig. 1g].[46]

In a meta-analysis of 12 MSICS studies comprising 14,94,307 eyes, intracameral moxifloxacin was used in 48.5% of eyes. The incidence of endophthalmitis in eyes with intracameral antibiotics was 0.02% (144/725324). There were 547 cases of endophthalmitis in MSICS cases operated without intracameral antibiotics, the risk ratio of postoperative endophthalmitis being 2.94 (95% CI, 1.07–8.12; P = .037) in these as compared to eyes where intracameral antibiotics were used.[47]

A higher incidence of endophthalmitis was reported in charity patients (33/26515, 0.12%) compared to private patients (1/2855, 0.04%) citing advanced cataracts and less stringent infection control procedures as the cause.[48] Routine prophylactic use of intracameral antibiotics was thus suggested as a cost-effective measure to improve the safety of MSICS.[49]

Late Postoperative Complications

Endothelial cell count (ECC) loss and pseudophakic bullous keratopathy (PBK)

PBK has been reported in 0.5% (1/200)[50] and 0.29% (2/689)[32] of eyes following MSICS. Endothelium needs to be protected by continuous injection of OVD, maintenance of anterior chamber depth, and creation of an appropriately sized wound to minimize anterior chamber manipulation, especially in very old patients and hard brown cataracts.[51]

Given the extensive nucleus maneuvering in the anterior chamber in MSICS, as compared to in-the-bag nuclear fragmentation in PE, a higher ECC loss is expected in MSICS. However, comparable ECC loss was demonstrated in conventional extracapsular cataract extraction (4.72 ± 13.07%), MSICS (4.21 ± 10.29%), and PE (5.41 ± 10.99%), respectively in nucleus sclerosis grade ≤3 at 6 weeks postoperatively.[52] In another study where black cataracts were excluded, the ECC loss at 6 weeks was 15.5% in the PE group and 15.3% in the MSICS group using the viscoexpression technique.[53]

Mathew *et al*. reported an ECC loss of 7.67 ± 9.2% and 16.58 ± 12.9% at 6 weeks and 3 months, respectively, using Blumenthal's technique. The ECC loss was observed to be more in diabetics but did not reach statistical significance in their series.[54] Kudva *et al*. later demonstrated a significantly greater ECC loss in diabetics at 1 and 3 months postoperatively, unrelated to HbA1c or duration of diabetes.[55] Increased rates of ECC (19.2%) have also been reported in uveitic cataracts at 6 months.[56]

Cystoid macular edema (CME)

A larger incision size, greater tissue trauma, and iris manipulation were found to be associated with increased chances of breakdown of the blood-retinal barrier in MSICS in comparison to PE. The authors found a subclinical increase in macular thickness in MSICS cases, without any evidence of CME either clinically or on optical coherence tomography.[57] At 3 months post-surgery, though the foveal thickness was higher in MSICS than PE, it did not reach statistical significance.[58]

Posterior capsular opacification (PCO)

A variety of surgical measures are adopted to prevent PCO. The cortical cleaving hydrodissection of the nucleus followed by its rotation helps in removing the lens fibers and epithelial cells from the equator of the capsular bag.[59] The in-the-bag placement of IOL creates a barrier against the migration of equatorial lens epithelial cells over the posterior capsule. The overlapping of capsulorhexis over the IOL optic prevents PCO by a "shrink wrap" effect.[60] The formation of Soemmering's ring, however, was seen to depend more on the thoroughness of cortical clean-up than the haptic fixation pattern.[61]

With the introduction of square edge PMMA IOLs and a good cortical aspiration and polishing after MSICS, comparable PCO rates are achievable by both MSICS and PE.

The reported in MSICS vs. PE are 11.1% (4/50) vs. 6.8% (3/50) at 6 months,[62] 13.3% (4/30) vs. 6.6% (2/30) at 4 months,[30] and 8.71% (60/689) vs. 20.44%(121/592) beyond 1 year.[32]

Postoperative astigmatism

Postoperative astigmatism in MSICS depends on the nature of incision, suturing, use of topical steroids, and cauterization. External incisions placed closer to the limbus, short width of the tunnel, larger incisions, straight or smile-shaped incisions, unsutured wounds, excessive use of postoperative topical steroids, and excessive scleral cauterization induce greater astigmatism.[63] Surgically-induced astigmatism (SIA) up to 3.00 D has been observed depending on the interplay of variables affecting astigmatism.[64-67]

IOL malposition

Retained cortical matter, vitreous in the anterior chamber, optic capture with peripheral synechiae, improper placement of IOL with one haptic in the bag and the other in the sulcus or on the iris, partial ZD, or implantation of phacoprofile rigid IOL in the sulcus can result in IOL malposition [Fig. 1h]. IOL malposition rates in MSICS vary from nil to 3.33% (1/30).[30,32]

Retinal detachment

The majority of the published studies on MSICS have not reported retinal detachment.[52,53,57,68-71]

Dry eyes

A transient occurrence of dry eyes has been observed following cataract surgery.[72]

The surgical interruption of afferent or efferent circuits regulating the lacrimal gland secretion, production of inflammatory mediators causing tear film instability, drug preservative-induced disturbance in the lipid layer, incisional site surface irregularity, and decrease in mucin production due to goblet cell destruction cause dry eyes following cataract surgery.[73,74] Using the ocular surface dryness index (OSDI) questionnaire 12 weeks post-surgery, 74% (37 of 50) of MSICS and 28% (14 of 50) of PE cases showed dry eye signs. A greater severity was seen in the MSICS group, with 56% being moderate and 18% severe dry eye than in the PE group, which had 24% moderate, 2% severe, and 2% mild dry eye cases.[75] Post MSICS, a predominance of severe dry eye was observed by Jayashree *et al*.[76] and mild dry eye by others.[74,77]

MSICS in Special Situations

Subluxated cataract

MSICS can be easily performed in subluxations less than 90°. In cases with larger subluxations, the creation of a large-sized capsulorhexis and nuclear prolapse of hard cataract out of

Table 1: Comparison of complication rates between MSICS, phacoemulsification, and ECCE techniques

Authors of the study	Type of cataract surgery performed	Sample size	Complications	Conclusions
Khanna *et al*.[8]	Phacoemulsification	507 eyes	PCR=4.3%, ZD=1.4%, Broken haptic=1.2%, Retained nuclear piece=0.2%, Endophthalmitis=0.4%	SICS has a higher complication rate than phacoemulsification, with comparable visual outcomes
	MSICS	522 eyes	PCR=6.9%, ZD=3.8%, capsulorhexis extension=0.4%, ID=0.6%, DMD=1.3%, Endophthalmitis=0.2%	
Kamonporn *et al*.[32]	MSICS	689 eyes	PCR=3.21%, Vitreous loss=3.19%, Hyphaema=4.35%, Iris prolapse=3.05%, DMD=1.16%, ID=0.73%, ZD=0.58%, Corneal edema=2.18%, PCO=8.71%, IOL malposition=0.15%, CME=0.15%, PBK=0.29%	Visual acuity was better post-phacoemulsification than MSICS. However, postoperative complication rates were higher following phacoemulsification than MSICS.
	Phacoemulsification	592 eyes	PCR=3.05%, Vitreous loss=1.02%, Hyphaema=0.17%, Iris prolapse=0.34%, DMD=1.02%, ZD=0.34%, Corneal edema=1.35%, PCO=20.44%, IOL malposition=0.34%, CME=0.17%, PBK=0.17%, RD=0.17%	
Ahangar *et al*.[30]	Phacoemulsification	30 eyes	PCR=13.3%, PCO=6.7%, Corneal edema=6.7%, RD=3.3%, Dislocated IOL=6.7%	Sutureless small-incision surgeries offer better visual outcomes and patient satisfaction in cataract cases.
	MSICS	30 eyes	PCR=6.7%, ID=6.7%, PCO=13.3%, Pupillary IOL capture=3.3%, Dislocated IOL=3.3%,	
	ECCE	40 eyes	PCO=12.5%, Endophthalmitis=2.5%, Pupillary IOL capture=2.5%	
Haripriya *et al*.[7]	Phacoemulsification	20,438 eyes	PCR=0.6%, Vitreous loss=0.47%, ZD=0.13%, Nucleus drop=0.09%, IOL drop=0.02%, Surgical Aphakia=0.01%, Endophthalmitis=0.05%	Complication rates are comparatively lower with SICS and phacoemulsification for experienced surgeons. Complications are significantly higher for trainee surgeons with phacoemulsification than for SICS.
	MSICS	53,603 eyes	PCR=0.5%, Vitreous loss=0.45%, ID=0.03%, ZD=0.09%, Nucleus drop=0.02%, IOL drop=0.01%, Surgical Aphakia=0.05%, Endophthalmitis=0.03%, DMD=0.01%, Suprachoroidal hemorrhage=0.01%	
Cook *et al*.[68]	Phacoemulsification	100 eyes	PCR=4%, Vitreous loss=3%, Corneal edema=35%	Phacoemulsification has better results, but SICS can be an acceptable alternative in middle- and low-income communities.
	MSICS	100 eyes	PCR=10%, Vitreous loss=6%, Corneal edema=29%	
George *et al*.[52]	Phacoemulsification	60 eyes	Endothelial cell loss=5.4% at 2 months follow-up	No significant endothelial loss was noted between phacoemulsification, SICS, and ECCE cases.
	MSICS	53 eyes	Endothelial cell loss=4.2% at 2 months follow-up	
	ECCE	52 eyes	Endothelial cell loss=4.7% at 2 months follow-up	
Gogate *et al*.[39]	Phacoemulsification	199 eyes	PCR=3.5%, ID=1%, Nucleus drop=0.5%, ZD=1%, capsulorhexis extension=1%, Corneal edema=9%, Retained cortex=1.5%, Anterior uveitis=2%, CME=0.5%, Glaucoma=0.5%, Pupillary capture=0.5%	Phacoemulsification and SICS have comparable safety and efficacy for visual rehabilitation of cataract cases.
	MSICS	201 eyes	PCR=6%, ID=1%, ZD=1%, DMD=0.5%, Corneal edema=4.5%, Retained cortex=2%, Anterior uveitis=2.5%	
Gogate *et al*.[53]	Phacoemulsification	100 eyes	PCR=6%, capsulorhexis extension=2%, Cortical drop=1%, Corneal edema=7%, Retained cortex=4%, Decentered IOL=1%, Endothelial cell loss=18.4% at six weeks follow-up	No significant differences in endothelial cell counts and complications were noted between SICS and phacoemulsification.
	MSICS	100 eyes	PCR=4%, capsulorhexis extension=1%, ID=1%, Corneal edema=7%, Retained cortex=5%, Endothelial cell loss=17.6% at six weeks follow-up	
Ruit *et al*.[69]	Phacoemulsification	54 eyes	PCR=1.85%, Vitreous loss=1.85%, capsulorhexis extension=1.85%, Nuclear fragment drop=1.85%, PCO=85.4%, Hyphaema=1.85%	SICS is faster, cheaper, and less technology-dependent than phacoemulsification, with similar complication rates.
	MSICS	54 eyes	PCO=56.5%, Hyphaema=29.6%,	

Contd...

Table 1: Contd...

Authors of the study	Type of cataract surgery performed	Sample size	Complications	Conclusions
Singh *et al*.[70]	Phacoemulsification	93 eyes	PCR=2.2%, Vitreous loss=2.2%, Nucleus drop=1.1%, Corneal edema=4.3%	No significant difference is noted in visual outcome between SICS and phacoemulsification
	MSICS	89 eyes	ZD=1.1%, Anterior uveitis=1.1%, Anterior uveitis=1.1%	
Venkatesh *et al*.[71]	Phacoemulsification	133 eyes	PCR=2.2%, Corneal edema=18.7%, Surgical Aphakia=0.9%,	SICS is faster, less expensive, less technology dependent and has equivalent visual outcomes, with low complication rates. SICS may be a more appropriate technique for mature cataracts in the developing world.
	MSICS	137 eyes	PCR=1.4%, Corneal edema=10.2%,	
Haripriya *et al*.[49]	Phacoemulsification	628269 eyes	PCR=8.2%, Endophthalmitis=0.03%	PCR and endophthalmitis rates were similar between phacoemulsification and SICS cases.
	MSICS	1402008 eyes	PCR=3.72%, Endophthalmitis=0.05%	
	ECCE	32366 eyes	PCR=12.78%, Endophthalmitis=0.08%	
Garg *et al*.[74]	Phacoemulsification	64 eyes	Dry eye signs in 15.6% of cases 1-month follow-up	The incidence of dry eye disease after cataract surgery is higher, with normalization of tear film parameters toward 1-month follow-up.
	MSICS	56 eyes	Dry eye signs in 26.8% of cases at 1-month follow-up	
Bista *et al*.[76]	MSICS	50 eyes	Dry eye=74%	Dry eye indices show a more significant change post-surgery in MSICS than phacoemulsification eyes.
	Phacoemulsification	50 eyes	Dry eye=28%	
Bhargav *et al*.[82]	MSICSin Fuchs' heterochromic iridocyclitis	65 eyes	Retained cortex=5.2%, ID=2.7%, PCO=21%, Corneal edema=11.4%, Anterior uveitis=5.4%, CME=12%, Glaucoma=6.7%, Endothelial loss of 19.2% of pre-operative values	MSICS is a viable alternative to phacoemulsification in Fuchs' heterochromic iridocyclitis, with good visual outcomes and a low rate of complications.
	Phacoemulsification in Fuchs' heterochromic iridocyclitis	75 eyes	Retained cortex=4.2%, PCO=18.6%, Corneal edema=17.1%, Anterior uveitis=4.6%, CME=8.6%, Glaucoma=4.6%, Endothelial loss of 20.5% of pre-operative values	
Bhargav *et al*.[56]	MSICS in uveitic cataract	80 eyes	Endothelial cell count loss of 26.4% at 6 months follow-up, PCO=21%, Persistent uveitis=16%, CME=12%, Corneal edema=11.4%, Retained cortex=5.2%, glaucoma=2.7%, Iridodialysis=2.7%	MSICS has similar endothelial cell loss and complication rates as phacoemulsification. Higher anterior chamber maneuvering causes greater endothelial cell loss.
	Phacoemulsification in uveitic cataract	75 eyes	Endothelial cell count loss of 31.4% at 6 months follow-up, PCO=18.6%, Persistent uveitis=12.8%, CME=8.6%, Corneal edema=17.1%, Retained cortes=4.2%, glaucoma=5.7%	
Goel *et al*.[78]	MSICS±capsule stabilizing devices	20 eyes	Zonular dialysis=13.33%, Escaped capsulorhexis=13.33%, Aphakia=10%, IOL decentration=3.33%, Anterior uveitis=3.33%, CME=3.33%, vitreous hemorrhage=6.67%	Subluxated cataracts can be effectively managed by both MSICS and phacoemulsification.
	Phacoemulsification ± capsule stabilizing devices	20 eyes	Zonular dialysis=13.33%, Escaped capsulorhexis=3.33%, Aphakia=23.33%, IOL tilt=3.33%, Anterior uveitis=3.33%, CME=3.33%	

CME – Cystoid macular edema, DMD – Descemet's membrane detachment, ID – Irido-dialysis, PBK – Pseudophakic bullous keratopathy, PCO – Posterior capsule opacification, PCR – Posterior capsule rent, RD – Retinal detachment, ZD – Zonular dialysis

the capsular bag may further increase the ZD. In subluxation associated with lens coloboma, PE is preferred as the nucleus may fail to rotate within the capsular bag. Capsular bag retention with PCIOL implantation could be accomplished in 76.67% (23/30) of eyes with subluxated cataracts of varying degrees using modified Blumenthal's technique.[78]

Phacomorphic glaucoma

The presence of corneal edema, hard nuclei, weak zonules, and shallow anterior chamber depth was reported to increase the surgical risk of PE in phacomorphic glaucoma. MSICS was shown to have a favorable outcome in terms of Visual outcome and safety in these cases.[79,80]

Chorioretinal colobomas

The intraoperative complications reported in MSICS performed in 115 eyes with iridofundal coloboma, were escaped capsulorhexis in 4.34% (5/115), large ZD in 1.73% (2/115), PCR in 3.47% (4/115), DMD in 2.60% (3/115), and Descemet's membrane loss in 0.86% (1/115). The chorioretinal colobomas associated with hard nuclei and small eyes further increased the risk of endothelial trauma while prolapsing the nucleus into the anterior chamber. The authors found similar outcomes in both MSICS and PE groups. Poor functional outcomes were seen in cases with microcornea, macula involving fundal coloboma, and intraoperative complications.[81]

Conclusion

MSICS is a closed chamber cataract extraction technique, safely performed under topical or injectable anesthesia, and extensively used for high volume and charity surgeries. MSICS and PE have been compared extensively in various studies showing comparable complication rates [Table 1]. Incisions with poor integrity should be sutured to minimize the occurrence of SIA and endophthalmitis. Given the elongated irido-nuclear contact during nuclear manipulation and prolapse of the complete nucleus from the capsular bag, repeated injection of OVD prevents endothelial damage and iritis. Nuclear delivery with extensive intracameral instrumentation should not be employed in compromised corneas. Inferior iridodialysis is unique to techniques utilizing microvectis. ZD is commonly seen with aggressive nuclear manipulation through small capsulorhexis. An appropriately sized triplanarsclero-corneal tunnel construction, adequately sized capsulorhexis, and gentle intracameral maneuvers under OVD cover result in good postoperative outcomes.

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Conflicts of interest

There are no conflicts of interest.

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