Effectiveness and Complication Profiles of Cataract Surgery: A Systematic Review

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Abstract.
Cataract is the most common cause of the reversible loss of sight globally. Given that phacoemulsification is regarded as the gold standard, manual small-incision cataract surgery (MSICS) still has an important role to play in resource limited settings. This systematical literature review assessed the outcomes in terms of effectiveness, visual outcomes, and complication rates of current cataract surgery techniques. Systematical search of literature was performed in Pub Med and ScienceDirect for papers published from 2021 to 2026, which compared cataract surgical techniques. Studies that included adult patients undergoing cataract surgery with follow-up data postoperatively for visual outcome and/or complications were included. The qualitative synthesis resulted in 607 records being screened and 32 studies being included which involved 200000 eyes. Study characteristics, surgical procedures and visual results and complications were retrieved and quantified. Appropriate methodological tools were used to evaluate the risk of bias. Both Phaco and MSICS had excellent visual improvement following the surgery, and the long-term visual recovery was similar in both groups except for rare cases where the surgery was complicated by retinal problems such as posterior capsular opacity (PCO) sometimes caused by intra-operative capsular balloon (IOB) removal. Phaco achieved superior results in early postoperative uncorrected visual acuity and smaller size of incision, resulting in less SIA. In dense nuclear cataract, however, MSICS was found to have lower endothelial cell loss without any loss in its cost-effectiveness in low resource areas. The most common complications reported were posterior capsule opacity and posterior capsule rupture. Advanced age and surgical complications were also related to outcomes. The techniques (phaco and MSICS) provided good visual outcomes after the cataract surgery. The surgical selection should be customized according to the severity of the cataract, the presence of intraocular co-morbidities and the surgeon's skills and health care resource availability.

Keywords: *Cataract, Phacoemulsification, Manual Small-Incision Cataract Surgery (MSICS) and Visual Outcomes.*

I. INTRODUCTION

In developing world, the leading cause of preventable blindness is cataract, which is also a significant health problem in low and middle income countries. The recent surgical developments such as extracapsular cataract extraction (ECCE), manual small incision cataract surgery (MSICS) and phacoemulsification have been a significant contribution to the visual rehabilitation and healing process following cataract surgery; however, the relative benefits of these procedures, their availability, and their potential risks remain the subject of debate.The gold standard is phacoemulsification but this is very expensive, very technologically demanding and difficult to practice in resource poor countries where MSICS can be practiced and is quite affordable (17 Othman). Furthermore, specific postoperative complications, surgically induced astigmatism, loss of endothelial cells, and patient-reported visual results are concerns that emphasize the need to compare in-depth the different surgical techniques currently available (19 Dole). Thus, this systematic review is designed to review the effectiveness and complications of cataract surgery and provide evidence to optimize clinical practice and global cataract management strategies (31 Kumar).

II. METHODS

The aim of this systematic review was to evaluate the visual outcomes and complications of manual small incision cataract surgery (MSICS) in comparison with phacoemulsification in a systematic, transparent and reproducible manner. Introduction to publications and search.

Literature review and search strategy.

A thorough literature survey was done on electronic databases - such as pubMed and ScienceDirect - and research articles concerning the methods applied in cataract surgeries and post-cataract surgery results were chosen. The search was done on publications between the period of January 2021 and December 2026. This study carried out a medical systematic review. Core ophthalmological terms such as cataract surgery were used for literature retrieval, Boolean AND/OR operators were applied to narrow the search scope. All published studies that were written in English were accepted.

Eligibility Criteria

Studies were chosen by applying the methodological and clinical criteria that were predetermined. This study established a unified preliminary screening standard for literature on cataract surgery research. We included literature published between 2021 and 2026 that took adult patients aged 18 years or older as study subjects and reported surgical complications or visual function outcomes. We excluded ineligible literature including reviews, animal studies, studies with insufficient sample sizes, and studies with a follow-up period of less than one month.

Study Selection

The study screening was strictly conducted in accordance with the international PRISMA guidelines. Removing duplicate and titles, articles were further screened for study eligibility based on pre-defined inclusion and exclusion criteria (full text and abstract).

Data Extraction

A standard data collection form was used with all the included studies to ensure methodological consistency and accuracy of the data across studies. Extracted variables included characteristics of the study (author, year of publication, country of origin, study design, study sample size), clinical and surgical parameters (patient population, type of surgical intervention, duration of follow-up). Assessment methods of visual acuity, pre and postvisual acuity, degree and timing of visual improvement were used as outcome measures. Further, if any complications were reported in the studies during the operation or after the operation, they were discussed and analyzed.

Risk of Bias Assessment

Study design and methodological quality were used to assess the studies for risk of bias. Overall, the selection bias in RCTs was generally small, with appropriate allocation concealment and randomisation procedures, and where performance bias may not have been avoided, for example in surgical procedures, it was of less importance. Observational and retrospective studies were assessed with the Newcastle-Ottawa Scale, and were of moderate risk of bias because they were not randomized, were limited by lack of blinding, may have been confounded, involved surgeon variation, had unequal baseline characteristics, had short follow-up, and lacked complete postoperative data. The majority of studies were considered to be at low to moderate risk of bias, with a few quasi-experimental studies being at higher risk.

III. RESULT AND DISCUSSION

A total of 607 records were identified after a database search and 598 records were eliminated when duplicates were removed. After screening the title and abstract, 414 studies were excluded due to not matching the inclusion criteria. These were excluded from further consideration because of inadequate or non-quantifiable outcome reporting (58), inappropriate study design (37, case reports or fewer than 40 eyes), insufficient follow up (less than 1 month) (29), unrelated surgical focus or interventions not investigated (not related to the cataract surgery techniques of interest) (18), and duplicate or overlapping datasets (10). Finally, 32 studies were included in the final qualitative synthesis, following PRISMA guidelines.

According to this systematic review, there were 32 studies satisfying the inclusion criteria that included data from over 200,000 eyes, including one large national registry study of 180,776 patients (1 Kongsap). The age of subjects was from 18 to 99 years with most patients in the age group 61-80 years (1 Kongsap). The modalities of cataract surgery addressed are Phaco, MSICS, FLACS and ECCE (1 Kongsap).

As a whole, all the surgical techniques had a significant improvement in the postoperative visual function (1 kongsap). In a large registry study conducted in Malaysia, 96.4% of patients had an improvement in their visual acuity after Phaco surgery(1 kongsap). The same study in Egypt showed that the incidence of

legal blindness was reduced from 92.2% before surgery to 1.9% one month after surgery with the use of MSICS (11 Atima). The majority of studies reported similar long-term (4-6 weeks or more) best-corrected visual acuity (BCVA) results for Phaco and MSICS (1 kongsap). However, Phaco had a better early postoperative uncorrected visual acuity (UCVA) than MSICS (1 kongsap). FLACS showed either slightly better or more similar visual results to conventional Phaco especially regarding early refractive stability. (1 kongsap).

As far as safety outcomes are concerned, MSICS had a consistently higher effect on surgically induced astigmatism (SIA) because of the larger incision size (6–7 mm versus 2.2–3 mm for Phaco (16 Elshaar)) . MSICS was also superior to the Phaco group(7 Singh) in terms of endothelial cell loss (ECL) in cases of hard nuclear cataract (7.1% vs. 13.2%). On the other hand, FLACS had the benefit over traditional Phaco in post vitrectomy eyes, where ultrasound energy(28 Asif) was lower. The most frequent LTC was posterior capsule opacity (PCO) (24 Munaje). Many studies have shown that the PCO was more common in the Phaco group and that hydrophilic acrylic intraocular lenses (IOLs) were used more often than polymethyl methacrylate (PMMA) lenses, which were the ones most often used in MSICS(24 Munaje). Posterior capsule rupture (PCR) ranged from 1% to 14% based on complexity of the case and characteristics of the patient (3 Pathak). Patients over 80 years of age may have high rates of complications during surgery. (11 Atima)

In particular clinical circumstances, the outcomes were found to be different depending on the surgical method applied(11 Atima) . The combination procedures like Phaco-trabeculectomy or MSICS-trabeculectomy and newer methods like Gonioscopy-assisted transluminal trabeculotomy (GATT) were effective in decreasing intraocular pressure and significantly improving visual acuity(24 Munaje) in patients with concomitant glaucoma. In eyes with uveitis, Phaco was generally used rather than MSICS as it had lower incidence of postoperative PCO and vitritis(30 shekar). Cataract surgery in nanophthalmos was thought to be fairly safe and around 64% of patients had improvement in vision, but there was significant risk of postoperative myopic shift(22 Lai) (6 Jason) . Phaco showed a better 1-month BCVA result than MSICS and risk of PCR was similar between the two(3 Pathak) in posterior polar cataracts.

Multinomial regression analyses(1 kongsap) (10 Bui) identified that several predictors of poor visual outcomes were identified. Ocular comorbidities such as age-related macular degeneration (AMD), diabetic retinopathy and glaucoma were the strongest factors associated with suboptimal postoperative visual outcomes(1 kongsap) . Surgical factors such as surgery lasting more than 60 minutes, lack of insertion of IOL (aphakia) and surgical complications such as vitreous loss were also highly correlated with the poorer visual recovery(1 kongsap) . Furthermore, sex (male) and age (advanced) were reported to be risk factors for postoperative visual improvement(1 kongsap) in several population-based studies. MSICS was always considered highly cost effective and technology independent, and hence was ideal for the developing countries with high burden of cataract and low healthcare resources(1 kongsap) . However, both treatments, MSICS and Phaco significantly enhanced patients' quality of life and their daily visual functioning as determined by the Catquest questionnaire(1 kongsap).

This systematic review shows that the overall success of modern cataract surgery is very high—with most studies showing that best-corrected visual acuity (BCVA) of >6/18 in >90% of patients(11 Atima) . However, the clinical outcome profile differences were noted between the two techniques (Phacoemulsification (Phaco) and manual small incision cataract surgery (MSICS) (1 kongsap) were identified. For both visual rehabilitation and early postoperative uncorrected visual acuity (UCVA) (1 kongsap), Phaco consistently provided better results. The ability to make a smaller incision may be responsible for the less inflammation after surgery and Refractive changes (18 Hassan) 2. A few studies found, however, that post stabilization wound healing BCVA for Phaco and MSICS were similar after a certain period of time(19 Dole) . These results indicate that both methods are equally effective in the long term on a functional basis, although they differ in terms of the speed of visual recovery in the early post-operative period(1 kongsap).

The primary difference between both surgical techniques is their safety and complications after surgery(1 kongsap) . Surgery-induced astigmatism (SIA) is correlated with MSICS, as it has a larger incision size of 6-7 mm compared to 24 Munaje phaco procedures, which has a size of 2.8-3 mm (MSICS) . This

postoperative astigmatism can have an impact on the early quality of vision and is one of the main drawbacks of MSICS(19 Dole) . MSICS, however, did show significant benefit in maintaining integrity(1 kongsap) of the corneal endothelial in the cases of dense nuclear cataracts. During Phaco, endothelial cell loss (ECL) could be more with the nuclei being fragmented by the higher ultrasonic energy, while mechanical extraction of the nucleus during MSICS is associated with lesser thermal and intraocular turbulence-related endothelial cell damage (7 Singh) . Other studies such as the study of Singh et al. have shown significantly less ECL in MSICS than in Phaco in grade III or IV cataract. Hence, MSICS is still safe and pertinent, especially for mature or hypermature cataract with dense nucleus(1 kongsap).

Furthermore, the results of this review underscore the need for personalized surgical strategies tailored to individual eye diseases. In the subject of uveitis, Phaco seems to be more advantageous than MSICS since it has been seen to be having lower incidence of posterior capsule opacity (PCO) and postoperative vitritis (11 Atima) . Combined procedures like Phaco trabeculectomy (10 Bui), and more recent procedures like gonioscopy-assisted transluminal trabeculotomy (GATT) (1 kongsap) have been proven effective in controlling intraocular pressure and at the same time, improving visual acuity (10 Bui) in glaucoma patients. Moreover, femtosecond laser-assisted cataract surgery (FLACS) provides benefits such as less ultrasound energy and less endothelial damage in post-vitrectomy eyes than Phaco (11 Atima) . Even in eyes with high complication rates as seen in literature(1 kongsap) cataract surgery may be safely performed in anatomically complex eyes like nanophthalmos and coloboma(1 kongsap) . In such cases, the selection of surgical technique should take into account the diameter of the cornea, the stability of the zonule and the anterior segment anatomy(1 kongsap) Intracapsular cataract extraction (ICCE) remains limited, as a last resort, in situations where there is massive zonular damage(1 kongsap) .

In terms of economic and health care efficiency, MSICS still has significant strategic value particularly in countries that lack sufficient health care resources in low and middle-income groups(1 kongsap) . The technique is fairly independent of the use of expensive technology and allow high volume cataract surgery at much lower cost without affecting the long term visual results(1 kongsap) . As a result, MSICS is an essential strategy in blindness prevention initiatives in the developing world, including India, Nigeria, and Egypt. However, in more affluent healthcare environments, Phaco and FLACS are the preferred options due to the increased patient comfort, increased visual rehabilitation, and more predictable refractive outcomes (1 kongsap). These differences suggest that not only the clinical effectiveness but also the level of resources, economic factors and population healthcare needs (1 kongsap) all have an impact on the choice of cataract surgery technique.

Patient-related factors and ocular comorbidities (1 kongsap) have an important influence on the postoperative visual outcomes in addition to surgical technique. The most important contributing factors to suboptimal postoperative visual acuity include diseases like age-related macular degeneration (AMD), glaucoma, and diabetic retinopathy. Older age (over 80 years) has also been linked to lower visual results because of decreased visual functional reserve and increased rates of associated ocular disease (10 Bui). Several other population-based studies also reported that men had a higher risk of visual deterioration, but the reasons behind this remain unknown. Comprehensive preoperative evaluation is still fundamental, and therefore, it is important to determine visual prognosis, in order to select the best surgical strategy for each patient (2 Kohlin). (25 Airyalat).

In conclusion, this systematic review suggests that no one single surgical technique for cataract surgery is better in all situations. In dense cataracts, MSICS is more safe and in fast visual rehabilitation, Phaco can be more beneficial (1 kongsap) while in terms of more cost-effective, MSICS is more beneficial (1 kongsap). The five core dimensions need to be addressed in surgical planning and it is not possible to develop a uniform approach to all surgical procedures. (24 Munaje)

IV. CONCLUSION

Phacoemulsification (Phaco) and manual small incision cataract surgery (MSICS) yield excellent, similar long term visual outcomes with most patients achieving a good improvement in their postoperative vision. In contrast, MSICS is a safe, effective and cost-effective alternative, with less endothelial cell loss

and less technological dependence, especially in resource limited countries, for dense nuclear cataract, and faster visual rehabilitation by Phaco, better early postoperative uncorrected visual acuity (16 Elshaar) and lower surgically induced astigmatism (1 kongsap). The surgical outcome depends on the surgical technique used but also on ocular comorbidities, patient age, complications during surgery and complexity of the case. The choice of cataract surgery techniques needs to be tailored to the patient, depending on the severity of the cataract, the presence of other eye conditions, the surgeon's experience and the availability of health care resources, to ensure optimal visual outcomes and contribute to the global programme of reducing cataract blindness. (7 Singh).

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