A Comparative Study of Outcome of Visual Acuity of Manual Small Incision Cataract Surgery in Diabetics and Non-Diabetics

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ABSTRACT

Background: Cataract is the leading cause of reversible blindness worldwide, with a higher prevalence in patients with diabetes mellitus. Diabetes accelerates cataract formation and may influence postoperative visual recovery and complication rates. Manual Small Incision Cataract Surgery (MSICS) is widely used in resource-limited settings due to its cost-effectiveness and good visual outcomes.

Objective: To compare postoperative visual acuity outcomes following manual small incision cataract surgery in diabetic and non-diabetic patients.

Methodology: A comparative observational study was conducted in a tertiary care hospital. A total of 80 patients undergoing MSICS were included, with 40 diabetic and 40 non-diabetic patients. Preoperative assessment and standard surgical procedures were performed. Postoperative visual acuity and complications were assessed at multiple follow-up intervals. Statistical analysis was performed using Chi-square and t-tests to compare outcomes between groups.

Results: A total of 80 patients were included, equally distributed between diabetic (50%) and non-diabetic (50%) groups. The mean age was comparable between diabetic (62.83 ± 8.38 years) and non-diabetic patients (61.78 ± 9.18 years) ($p = 0.594$).Significant improvement in visual acuity was observed in both groups following surgery. However, postoperative complications were more common in diabetic patients. Corneal edema was observed in 78.6% of diabetic

patients compared to 21.4% of non-diabetics. Iritis occurred in 62.5% of diabetics versus 37.5% of non-diabetics, while pigment deposits on intraocular lens were noted in 66.7% of diabetics compared to 33.3% of non-diabetics.

Conclusion: Manual small incision cataract surgery provides effective visual improvement in both diabetic and non-diabetic patients. Although diabetic patients have a higher incidence of postoperative complications and slower recovery, satisfactory final visual outcomes can be achieved with proper perioperative care and monitoring.

Keywords: Cataract, Diabetes Mellitus, Visual Acuity, MSICS, Postoperative Outcome

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Introduction

Cataract remains the leading cause of reversible blindness worldwide and is a major contributor to visual impairment, particularly in developing countries where timely access to surgical care may be limited. Increasing life expectancy and the growing prevalence of chronic metabolic diseases have further increased the burden of cataract-related blindness. Among these conditions, diabetes mellitus plays a pivotal role by accelerating cataract formation and influencing its progression and surgical outcomes. Consequently, diabetic patients often present unique challenges in cataract management compared with non-diabetic individuals. [1]

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia due to impaired insulin secretion, insulin action, or both. Its prevalence has risen dramatically worldwide, with India carrying one of the highest disease burdens. Besides diabetic retinopathy, cataract is one of the most common ocular complications of diabetes, affecting nearly two-thirds of patients during the course of the disease. Epidemiological studies indicate that individuals with diabetes are two to five times more likely to develop cataract than non-diabetics, with earlier onset and more rapid progression. [2,3]

The development of diabetic cataract is multifactorial. Chronic hyperglycemia activates the polyol pathway, leading to sorbitol accumulation within the lens, osmotic stress, oxidative damage, and disruption of lens fibers. In addition, non-enzymatic glycation of lens proteins, oxidative stress, and reduced antioxidant defenses contribute to lens opacification. These biochemical alterations frequently result in cortical and posterior subcapsular cataracts, which can significantly impair vision even at relatively early stages. [4]

Cataract surgery remains the definitive treatment for visually significant cataract. Although phacoemulsification is considered the standard surgical technique in many centers, manual small incision cataract surgery (MSICS) continues to be widely practiced in resource-limited settings because of its affordability, shorter learning curve, and excellent visual outcomes. MSICS is particularly advantageous for managing dense or mature cataracts, which are commonly encountered in rural populations and in diabetic patients presenting late for treatment.[5]

Despite advances in surgical techniques, cataract surgery in diabetic patients continues to raise concerns regarding postoperative visual recovery and complications. Diabetes has been associated with impaired corneal endothelial function, delayed wound healing, increased postoperative inflammation, cystoid macular edema, and progression of diabetic retinopathy, all of which may adversely affect visual outcomes. Even in the absence of clinically detectable diabetic retinopathy, subtle retinal microvascular changes may limit postoperative visual improvement. Therefore, comparison of visual outcomes between diabetic and non-diabetic patients provides valuable insight into the influence of

diabetes on surgical success. [6]

Visual acuity remains the most important indicator of cataract surgery success and reflects both the effectiveness of the surgical procedure and the functional integrity of the visual pathway. Several studies have reported that MSICS can achieve visual outcomes in diabetic patients comparable to those in non-diabetics when careful patient selection, meticulous surgical technique, and appropriate postoperative care are ensured. However, other studies have demonstrated higher rates of early postoperative complications and delayed visual rehabilitation among diabetics, resulting in inconsistent findings across the literature. These variations may be attributed to differences in patient characteristics, glycemic control, severity of diabetic retinopathy, study design, and duration of follow-up. [7]

Therefore, comparative assessment of visual acuity following MSICS in diabetic and non-diabetic patients is essential to generate context-specific evidence that can guide surgical planning, patient counseling, and postoperative management, ultimately improving visual outcomes and quality of care.

Materials and Methods

This comparative observational study was conducted in the Department of Ophthalmology, Vijayanagar Institute of Medical Sciences (VIMS), Ballari, from February 2024 to August 2025. The study included patients with age-related cataract undergoing manual small incision cataract surgery (MSICS). Eligible participants were divided into two groups: patients with type 2 diabetes mellitus (diabetic group) and non-diabetic patients (control group).

Patients aged 30–80 years who provided written informed consent were included. Patients with traumatic cataract, secondary glaucoma, uncontrolled hypertension, uncontrolled diabetes with renal involvement, or hyperlipidemia were excluded.

The calculated sample size based on previous literature was 444 participants (222 per group) at 95% confidence level and 80% power. However, due to the limited study duration and institutional surgical volume, all eligible consecutive patients undergoing MSICS during the study period were enrolled, yielding a final sample of 80 participants.

All patients underwent detailed preoperative evaluation, including demographic and medical history, comprehensive ophthalmic examination, and baseline visual acuity assessment. Standard MSICS was performed according to institutional protocols. Postoperative management was uniform for both groups.

Patients were followed on postoperative day 1, at 1 week, 6 weeks, and 12 weeks. The primary outcome was postoperative best-corrected visual acuity measured using the Snellen visual acuity chart. Secondary outcomes included postoperative complications such as corneal edema, anterior chamber inflammation, posterior capsular opacification, and cystoid macular edema. Macular edema was initially assessed using slit-lamp biomicroscopy with a 90D lens and confirmed by optical coherence tomography (OCT) of the macula when indicated. Slit-lamp examination and fundus evaluation were performed during each follow-up visit.

Data were recorded using a predesigned case record form and entered into a spreadsheet for analysis. Continuous variables were summarized as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Comparisons between diabetic and non-diabetic groups were performed using the Chi-square test for categorical variables. A p-value <0.05 was considered statistically significant. Statistical analysis was performed using SPSS software (version XX; IBM Corp., Armonk, NY, USA).

The study was approved by the Institutional Ethics Committee of VIMS, Ballari. Written informed consent was obtained from all participants before enrollment, and confidentiality of patient information was maintained throughout the study.

Results

Table 1. Baseline Characteristics of Study Participants According to Diabetic Status (N=80)

Variable	Diabetic (n=40)	Non-diabetic (n=40)	P value
Age (years), Mean ± SD	62.83 ± 8.38	61.78 ± 9.18	0.594
Female, n (%)	23 (57.5)	18 (45.0)	0.263
Male, n (%)	17 (42.5)	22 (55.0)	
Right eye, n (%)	20 (50.0)	22 (55.0)	0.654
Left eye, n (%)	20 (50.0)	18 (45.0)	
Common preoperative VA	6/60 (25)	6/60 (15)	0.095

A total of 80 patients were included, with 40 diabetic and 40 non-diabetic participants. The mean age was comparable between the diabetic and non-diabetic groups (62.83 ± 8.38 vs. 61.78 ± 9.18 years, p=0.594). There was no significant difference in sex distribution (p=0.263), operated eye (p=0.654), or preoperative visual acuity (p=0.095) between the two groups. These findings indicate that the study groups were well matched at baseline, minimizing potential confounding effects and allowing a reliable comparison of postoperative outcomes.

Table 2. Postoperative Complications Following MSICS

Follow-up	Corneal edema	Iritis	Pigment deposits	PCO	CME	No complication	P value
Day 1	14	8	3	-	-	55	0.055*
Week 1	14	8	3	-	-	55	0.045
Week 6	9	2	3	-	-	66	0.026
Week 12	4	-	-	7	-	69	0.013
Overall CME	4 DM vs 0 Non-DM	-	-	-	5	75	0.021

*Likelihood ratio significant (0.048).

Postoperative complications were consistently more frequent among diabetic patients throughout the follow-up period. Corneal edema was the most common complication, occurring predominantly in diabetic patients on postoperative day 1, week 1, week 6, and week 12. Iritis and pigment deposits on the intraocular lens were also more frequently observed in diabetics during the early postoperative period. Posterior capsular opacification at 12 weeks occurred mainly in diabetic patients, while cystoid macular edema developed exclusively in the diabetic group (12.5%). Significant associations between diabetes and postoperative complications were observed at week 1 (p=0.045), week 6 (p=0.026), week 12 (p=0.013), and for cystoid macular edema (p=0.021), indicating a higher postoperative complication rate among diabetic patients.

Table 3. Best Corrected Visual Acuity During Follow-up

Visual acuity	Day 1	Week 1	Week 6	Week 12
6/6	0	0	1	17

Visual acuity	Day 1	Week 1	Week 6	Week 12
6/9	1	4	22	28
6/12	11	17	20	19
6/18	13	15	17	2
6/24	20	23	8	5
6/36	19	8	5	4
6/60	11	9	5	4
5/60	4	3	-	-
1/60	1	1	1	1
P value	<0.001	<0.001	<0.001	<0.001

Postoperative visual acuity improved progressively in both diabetic and non-diabetic patients over the 12-week follow-up period. However, non-diabetic patients consistently achieved superior visual outcomes at every postoperative visit. On postoperative day 1 and week 1, poorer visual acuity categories were predominantly observed among diabetic patients, whereas better visual acuity (6/12–6/9) was more common among non-diabetics. By the sixth postoperative week, the majority of non-diabetic patients had attained visual acuity of 6/9 or better, while diabetic patients continued to demonstrate relatively poorer vision. At 12 weeks, all patients achieving 6/6 visual acuity belonged to the non-diabetic group, whereas poorer visual acuity categories (6/36 and 6/60) were observed exclusively among diabetic patients. The differences in postoperative visual acuity between the two groups were statistically significant at all follow-up visits ($p<0.001$).

Table 4. Final Visual Outcome and Diabetic Retinopathy

Variable	Good	Borderline	Poor	P value
Diabetic	27	12	1	0.019
Non-diabetic	37	3	0	
No DR	13	0	0	<0.001
NPDR	14	4	0	
NPDR + ME	0	4	0	
PDR	0	4	1	

Overall, good final visual outcome was achieved in 80.0% of patients following MSICS. Non-diabetic patients were more likely to achieve good visual outcomes than diabetic patients, whereas borderline and poor outcomes were predominantly observed among diabetics ($p=0.019$). Among

diabetic patients, non-proliferative diabetic retinopathy (NPDR) was the most common retinal finding (45.0%), while 32.5% had no evidence of diabetic retinopathy. All patients without diabetic retinopathy achieved good postoperative visual outcomes, whereas patients with NPDR associated with macular edema or proliferative diabetic retinopathy had predominantly borderline or poor visual outcomes. The severity of diabetic retinopathy showed a highly significant association with final visual outcome ($p<0.001$).

Table 5. Duration of Diabetes and Clinical Outcomes (n=40)

Duration	No DR	NPDR	NPDR+ME	PDR	Good outcome	Borderline/Poor	P value
<5 years	8	2	1	1	9	3	
5–10 years	5	9	0	3	12	5	
>10 years	0	7	3	1	6	5	
Association with DR							0.008
Association with final outcome							0.364

Mean duration = **7.30 ± 4.44 years**

The mean duration of diabetes among diabetic participants was 7.30 ± 4.44 years, with the majority having diabetes for 5–10 years (42.5%). Increasing duration of diabetes was significantly associated with greater severity of diabetic retinopathy ($p=0.008$). Patients with diabetes of less than 5 years' duration most commonly had no evidence of retinopathy, whereas all patients with diabetes exceeding 10 years demonstrated some degree of retinal involvement. Although the proportion of good visual outcomes decreased with increasing duration of diabetes, the association between diabetes duration and final postoperative visual outcome was not statistically significant ($p=0.364$), suggesting that retinal status rather than duration of diabetes alone had a greater influence on postoperative visual recovery.

Discussion

The present comparative observational study evaluated postoperative visual outcomes following Manual Small Incision Cataract Surgery (MSICS) in diabetic and non-diabetic patients. The findings demonstrate that although MSICS provided significant visual improvement in both groups, diabetic patients experienced slower visual recovery, a higher frequency of postoperative complications, and comparatively poorer final visual outcomes.

The baseline characteristics of the diabetic and non-diabetic groups were comparable with respect to age, sex, operated eye, and preoperative visual acuity, indicating that differences observed during follow-up were unlikely to be influenced by demographic or preoperative clinical disparities. Similar matching of baseline characteristics has been reported by Kudva et al. who emphasized that comparable study groups are essential for accurately evaluating the independent effect of diabetes on postoperative outcomes. Likewise, Lee et al., in a large population-based study, identified retinal disease and duration of diabetes rather than age alone as the principal determinants of postoperative visual recovery. [8,9]

A major finding of the present study was the consistently better postoperative visual acuity among non-diabetic patients throughout the 12-week follow-up period. Significant differences in best-corrected visual acuity were observed from postoperative day 1 through week 12 (all $p<0.001$). Although visual acuity improved progressively in both groups, non-diabetic patients achieved faster visual rehabilitation and superior final vision. At the final follow-up, all patients achieving 6/6 visual acuity were non-diabetic, whereas poorer visual

acuity categories (6/36 and 6/60) were observed exclusively among diabetic patients. These findings suggest that diabetes adversely influences both the rate and extent of visual recovery following MSICS. [10]

Delayed visual recovery in diabetic patients may be explained by several pathophysiological mechanisms. Chronic hyperglycemia induces endothelial dysfunction, oxidative stress, and basement membrane thickening, making the corneal endothelium more susceptible to surgical trauma. In addition, impaired wound healing and an exaggerated postoperative inflammatory response contribute to transient corneal edema and delayed restoration of corneal clarity. Previous studies have similarly reported greater endothelial cell loss and increased central corneal thickness in diabetic eyes after cataract surgery, resulting in slower early visual recovery despite satisfactory surgical outcomes. These mechanisms probably account for the poorer early postoperative visual acuity observed in the diabetic group in the present study. [7-10]

Postoperative complications occurred more frequently among diabetic patients throughout the study period. Corneal edema was the commonest complication during the early postoperative period, followed by iritis and pigment deposits on the intraocular lens. At 12 weeks, posterior capsular opacification and cystoid macular edema remained significantly more frequent among diabetic patients, with cystoid macular edema occurring exclusively in the diabetic group. The incidence of postoperative complications showed significant associations with diabetic status at week 1, week 6, and week 12.

These findings are consistent with previous studies demonstrating increased postoperative inflammation and macular complications among diabetic patients. Chen et al., in a recent meta-analysis, reported significantly higher rates of postoperative complications, including macular edema and posterior capsular opacification, in diabetic patients than in non-diabetic controls.[11] Similarly, recent clinical studies have shown that diabetes increases the risk of postoperative inflammatory changes because disruption of the blood-retinal barrier, increased vascular endothelial growth factor (VEGF) expression, and persistent low-grade inflammation predispose diabetic eyes to prolonged recovery. [12,13] The present findings further reinforce the importance of careful postoperative surveillance in diabetic patients undergoing MSICS.

Among diabetic patients, diabetic retinopathy had the greatest influence on postoperative visual outcome. Nearly two-thirds of diabetic participants demonstrated some degree of diabetic retinopathy, with non-proliferative diabetic retinopathy (NPDR) being the commonest retinal abnormality. Importantly, all diabetic patients without retinopathy achieved good postoperative visual outcomes, whereas patients with NPDR associated with macular edema or proliferative diabetic retinopathy had predominantly borderline or poor final vision. The relationship between diabetic retinopathy severity and final visual outcome was highly significant.[14]

These observations agree with several previous investigations showing that retinal status is the strongest predictor of visual recovery after cataract surgery in diabetic patients. Lee et al. demonstrated that increasing severity of diabetic retinopathy and diabetic maculopathy substantially reduced the likelihood of achieving optimal postoperative vision.[9] Similarly, Eriksson et al. reported that diabetic patients without pre-existing macular edema achieved visual outcomes comparable to non-diabetic individuals, whereas retinal edema significantly delayed postoperative recovery. [7]

The duration of diabetes also influenced retinal status in the present study. Increasing duration of diabetes was significantly associated with greater severity of diabetic retinopathy, although it did not independently predict final postoperative visual outcome. Patients with diabetes exceeding 10 years demonstrated more advanced retinal disease than those with shorter disease duration. However, after adjustment for retinal status, duration alone was not significantly associated with postoperative visual outcome. These findings suggest that chronic hyperglycemia exerts its effect primarily through the development of retinal microvascular complications rather than duration itself.

The strengths of the present study include the prospective comparative design, equal representation of diabetic and non-diabetic patients, standardized surgical technique using MSICS with posterior chamber intraocular lens implantation, and uniform follow-up at predefined postoperative intervals. In addition to serial assessment of visual acuity, the study evaluated postoperative complications, diabetic retinopathy, cystoid macular edema, and duration of diabetes, thereby providing a comprehensive evaluation of factors influencing postoperative visual recovery.

The study also has several limitations. The sample size was smaller than the calculated requirement because of the limited number of eligible patients during the study period, which may have reduced statistical power for subgroup analyses. The follow-up duration of 12 weeks was adequate for assessing early and intermediate postoperative outcomes but insufficient to evaluate long-term progression of diabetic retinopathy, posterior capsular opacification, or late-onset macular edema.

Conclusion

In conclusion, the present study demonstrates that MSICS provides substantial visual improvement in both diabetic and non-diabetic patients. However, diabetic patients experience slower visual recovery, more frequent postoperative complications, and comparatively poorer final visual outcomes. The severity of diabetic retinopathy and the presence of macular edema were the strongest predictors of postoperative vision, whereas duration of diabetes alone did not independently influence final visual outcome. Comprehensive preoperative retinal assessment, optimization of systemic diabetic control, and meticulous postoperative follow-up are therefore essential to maximize visual outcomes in diabetic patients undergoing cataract surgery.

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