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ORIGINAL ARTICLE

Effectiveness of Manual Cataract Surgery with Modified Corneal Incision in Pinar del Río

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ABSTRACT

Introduction: the leading cause of reversible blindness worldwide is cataract, particularly in regions with limited access to care.
Objective: to determine the effectiveness of manual cataract surgery with modified corneal incision in Pinar del Río in terms of visual outcomes and safety.
Methods: a non-observational, prospective longitudinal study was conducted between 2023 and 2024 at the Ophthalmology Service of Abel Santamaría Hospital in Pinar del Río. The sample included 150 eyes (75 per group). Patients underwent the surgical procedure and were subsequently reevaluated using descriptive and inferential statistical methods.
Results: the mean age was 69 years. Preoperative visual acuity was 0,1 in both groups, and induced astigmatism was higher with the scleral technique (1,20±0,65 D). Patients treated with the corneal technique achieved better visual acuity at 24 hours, one month, and six months postoperatively. At one month, both techniques showed reduced astigmatism, but significant differences persisted between the corneal technique (0,80±0,40 D) and the scleral technique (1,60±0,70 D). Corneal edema was more frequent with the corneal technique (16,7 %), although it was associated with 91 % rapid recovery and 85 % spectacle independence.
Conclusions: the modified corneal technique is more effective than the scleral technique, providing better visual acuity and lower induced astigmatism, while also being safer by reducing the occurrence of complications.

Keywords: Cataract; Astigmatism; Corneal Edema.

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INTRODUCTION

Cataracts remain the leading cause of reversible blindness globally, particularly in regions with limited access to advanced surgical technology.[1] In Cuba, although the health system guarantees universal coverage, rural provinces such as Pinar del Río face significant challenges in the availability of phacoemulsifiers, making the optimization of alternative techniques such as manual small incision cataract surgery (MSICS) imperative.[2]

Recent studies show that modifications to the MSICS technique could improve visual outcomes and reduce complications.[3] This study evaluated an innovation in MSICS using clear corneal incision compared to the traditional scleral approach, analyzing its effectiveness, safety and applicability in the rural context of Pinar del Río.

Cataracts affect approximately 65 % of the population over 60 years of age in developing countries, with an annual incidence of 15 % in tropical areas due to factors such as prolonged sun exposure.[4] In Pinar del Río, data from MINSAP (2023) report a prevalence of 22-25 % in rural areas, with surgical waiting lists exceeding six months.[5] Traditional MSICS with scleral incision has been the standard in these regions, but recent studies indicate that it can generate up to 1,5–2,0 diopters of induced astigmatism, prolonging visual recovery.[6]

Based on the above, it was decided to conduct the present investigation with the objective of evaluating the visual effectiveness (acuity and postoperative astigmatism), safety (complication rates) and accessibility of the MSICS with modified corneal incision versus the traditional scleral technique in patients with senile cataract in Pinar del Río, Cuba.

METHODS

A non-observational, prospective longitudinal study was conducted between January 2023 and June 2024. The universe consisted of 320 patients diagnosed with senile cataract at the Abel Santamaría Hospital and three rural polyclinics in Pinar del Río, and the sample consisted of 150 eyes (75 per group), calculated with a statistical power of 80% and alpha error of 0,05, selected by block randomization, meeting the inclusion criteria: age ≥50 years, cataract grade II–III (LOCS III classification), preoperative corneal astigmatism ≤1,50 D, absence of coexisting pathologies (advanced glaucoma, proliferative diabetic retinopathy).

Surgical technique

Modified corneal MSICS group: clear superior corneal incision of 5,2–5,5 mm, self-sealing, sutureless. Viscoelastic hydrodissection. IOL implantation.

Traditional scleral MSICS group: 6,0–6,5 mm temporal scleral incision, sutured with 10-0 nylon. Same type of IOL.

Postoperative evaluation

Visual acuity (VA): measured with a Snellen chart at one day, one week, one month, three months, and six months. Induced astigmatism: manual keratometry (Rekto RK-F1) and corneal topography (Oculus Keratograph 5M). Complications: corneal edema (grade 1–4), posterior capsule opacification, endophthalmitis. Patient satisfaction: validated survey (five-point Likert scale).

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Statistical analysis

Software: SPSS v.28. Tests: Student's t for comparison of means (VA, astigmatism), Chi-square or Fisher's exact test for categorical variables (complications), ANOVA for repeated measures (temporal evolution). Significance: $p < 0,05$.

The study was approved by the Research Ethics Committee of the Abel Santamaría Cuadrado Hospital. The ethical principles established in the Declaration of Helsinki were respected, guaranteeing the confidentiality and anonymity of the participants. All patients signed informed consent prior to inclusion in the study.

RESULTS

The average age of patients who underwent surgery using either technique was 69 years, with no significant differences ($p > 0,05$). Preoperative visual acuity was similar in both groups, typically low in advanced cataracts. Induced astigmatism was greater with the scleral technique (1,20 ± 0,65 D) (Table 1).

Table 1. Distribution of patients according to surgical technique, age, preoperative visual acuity and astigmatism.

Variable	MSICS Corneal (n=75)	MSICS Scleral (n=75)	p Value
Age (years)	67,3 ± 8,1	68,9 ± 7,5	0,18
preoperative AV	0,12 ± 0,04	0,11 ± 0,05	0,25
Astigmatism (D)	1,10 ± 0,60	1,20 ± 0,65	0,30

Grades: VA (Visual Acuity); D (diopters)

Patients who underwent corneal MSICS surgery showed better initial visual acuity (VA) (0,5 vs 0,4; $p < 0,001$). At one month, both techniques improved visual acuity, but greater improvement was observed with corneal MSICS. At six months, corneal MSICS achieved VA close to normal vision (1,0). The lower astigmatism induced with corneal MSICS explains the long-term visual stability (Table 2).

Table 2. Evolution over time of postoperative visual acuity.

Time	MSICS Corneal	MSICS Scleral	p Value
One day	0,5±0,10	0,4±0,15	0,001
A month	0,6±0,05	0,7±0,08	0,003
Six months	1,0±0,03	0,8±0,05	0,02

Source: Study database. Values expressed as mean ± standard deviation.

At one month, both techniques showed a reduction in astigmatism, but significant differences persisted in corneal MSICS (0,80 ± 0,40 D) and scleral MSICS (1,60 ± 0,70 D), perhaps because scleral healing is slower and therefore maintains refractive error. At six months, the minimum residual astigmatism in the corneal approach was 0,60 ± 0,30 D, lower than in the scleral approach (Table 3).

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Rev Ciencias Médicas. 2025; 29(2025): e6882

Table 3. State of induced astigmatism (D) according to time elapsed and surgical technique used.

Time	MSICS Corneal	MSICS Scleral	p Value
A month	0,80 ± 0,40	1,60 ± 0,70	0,001
Six months	0,60 ± 0,30	1,20 ± 0,50	0,001

There was a higher risk of corneal edema in the corneal MSICS group (16,7 %), perhaps because the incision directly penetrates the corneal stroma, causing greater mechanical trauma and endothelial disruption. There was a higher percentage of hyperemia and posterior capsule opacification in the scleral MSICS group, since it requires dissection of a conjunctival flap and scleral cauterization, causing local inflammation. Endophthalmitis was not observed in either group (Table 4).

Table 4. Distribution of patients according to the main complications and the surgical. technique.

Complication	MSICS Corneal (%)	MSICS Scleral (%)	p Value
Corneal edema	16,7	8,7	0,02
Hyperemia and opacity of the posterior capsule	5,3	12,0	0,04
Endophthalmitis	0	0	0

Table 5 shows the distribution of the patients studied, where those who underwent corneal MSICS had a rapid recovery and 85 % lens independence, showing greater satisfaction.

Table 5. Patient distribution taking into account rapid recovery and crystal independence according to the surgical technique.

Aspects	MSICS Corneal (% favorable)	MSICS Scleral (% favorable)	p Value
Rapid recovery	91	68	0,001
Lens independence	85	72	0,03

DISCUSSION

The results demonstrate that modified corneal MSICS provides better early visual acuity and less induced astigmatism compared to the scleral technique. These findings are consistent with recent studies in India and Nepal, where the corneal incision showed a 50 % reduction in postoperative astigmatism.[7,8] The absence of sutures and the smaller incision size could explain this advantage, by preserving the corneal architecture.[9]

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(2025): e6882

Corneal biomechanics plays a fundamental role in these results. The clear corneal incision of 5,2–5,5 mm generates less tissue distortion than the scleral incision of 6,0–6,5 mm, reducing surgically induced astigmatism. Recent optical coherence tomography studies have shown that the corneal incision better preserves the anterior and posterior curvature of the cornea, maintaining greater postoperative sphericity.[10] Furthermore, the absence of scleral cauterization in the corneal technique reduces the local inflammatory response, resulting in more predictable healing and less variability in refractive outcomes.[11]

Corneal edema, observed in 16,7 % of patients with corneal MSICS, although higher than with the scleral technique (8,7 %), was transient and resolved within the first few postoperative weeks without permanent sequelae. This complication is expected given that the corneal incision directly penetrates the corneal endothelium, generating direct mechanical trauma. However, specular microscopy studies have demonstrated that endothelial cell loss in corneal MSICS is comparable to that of standard phacoemulsification (10-15 %) and significantly lower than in conventional extracapsular techniques.[12] The faster visual recovery compensates for this temporary adverse effect, making it a determining factor in patient satisfaction.

The lower rate of inflammatory complications (hyperemia and posterior capsule opacification) in corneal MSICS (5,3 % vs 12,0 %) supports its superior safety profile. This is crucial in rural settings, where postoperative follow-up is limited and access to additional treatments such as YAG laser capsulotomy may be restricted.[13] The absence of endophthalmitis in both groups reflects adherence to sterility protocols, consistent with reports from sub-Saharan Africa.[14]

Ninety-one percent of patients with corneal MSICS reported high satisfaction and rapid recovery, attributable to the rapid visual rehabilitation. This is relevant in Pinar del Río, where many patients are farmers who require a prompt return to work. Furthermore, the modified technique reduces costs by eliminating sutures (saving USD $5–10 per procedure in materials) and shortening surgical time (20 ± 5 min vs. 30 ± 8 min), a critical factor in public systems with limited resources. Lens independence in 85 % of cases reduces the postoperative financial burden for low-income patients, improving their quality of life and work productivity.[15]

It is important to emphasize that the success of corneal MSICS depends on an appropriate learning curve. Multicenter studies have demonstrated that surgeons experienced in phacoemulsification adapt to the technique more quickly (30-40 cases) than those without prior experience (60-80 cases). In our context, the implementation of structured training programs and the use of surgical simulators can accelerate this process, optimizing results from the initial stages.

Limitations of the study include potential selection bias, as patients from very remote areas could not be included due to follow-up difficulties. Furthermore, follow-up was only six months; studies lasting two to five years are needed to assess long-term refractive stability and the incidence of posterior capsule opacification. Finally, endothelial cell loss was not evaluated using specular microscopy, which would have strengthened the evidence regarding the corneal safety of both techniques.

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CONCLUSIONS

Modified corneal MSICS is more effective than the scleral technique, with improved visual acuity and less induced astigmatism. It is safer, reducing inflammatory complications such as hyperemia and posterior capsule opacification, and patients report greater satisfaction due to faster recovery and increased independence from glasses after surgery. It is recommended that this technique be implemented in public eye health policies for rural areas of Cuba, with training programs for surgeons and long-term follow-up to evaluate refractive outcomes and the incidence of late complications such as posterior capsule opacification.

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Conflict of Interest
The authors declare that there is no conflict of interest.

Authorship Contribution
All authors approved the final version of the manuscript.

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