Visual Outcome Following Frown and Chevron Incision in Manual Small Incision Cataract Surgery: A Narrative Review

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Abstract: The incision in Small Incision Cataract Surgery plays an important role in determining postoperative outcomes. This narrative review examines and compares the frown and chevron incision techniques in Small Incision Cataract Surgery emphasizing on postoperative astigmatism, wound stability, surgical ease, and overall visual prognosis. After analyzing existing literature and studies, this review discusses the advantages and disadvantages of each incision type, drawing attention towards major decisive factors such as incision architecture, healing dynamics, and the surgeon's learning curve. The frown incision, known for its ability to minimize SIA, is contrasted with the chevron incision, which offers potential benefits in terms of wound stability and patient comfort. However, variations in surgical technique, patient demographics, and study designs across the literature make it challenging to establish a definitive superiority of one technique over the other. The review concludes that the choice between frown and chevron incisions should be tailored to the individual patient's needs and the surgeon's expertise, with an emphasis on achieving the best possible visual outcomes with minimal complications.

Keywords: Frown incision, Chevron incision, SICS

Introduction

Cataract surgery is one of the most frequent surgical operations that is conducted worldwide and approximately 20 million surgeries are conducted per year. The surgery is relevant to the restoration of vision and quality of life particularly in the seniors population [1]. Another common technique is Manual Small Incision Cataract Surgery (MSICS) which has gained more popularity, particularly in the lower income earner regions because it takes lesser time, it is cheaper and does not require sophisticated instruments[2]. This is the case in many areas of Asia and Africa

including those with negligible technological endowment and high burden of blindness due to cataract [3].

One of the major considerations as to the outcome of cataract surgery involves the particular type of scleral incision. The type of incision that is used affects SIA and the amount of postoperative improved visual acuity, as well as patient satisfaction [4]. Different incision plans have been made attempt, of which frown and chevron incisions are two of the popular incisions used in MSICS [5].

Frown incision is made anterior and at a higher position on the sclera. It was supposed to enhance the stability of the wound and reduces the rates of postoperative complications inclusive of infection or leakage [6]. It mimics a frown curvature so as to provide an equal distribution of tension on the suture line; this might help to lower SIA [7]. Nevertheless, it has been proved that the use of frown incision leads to moderate levels of SIA, resulting in average of SIA from 1. 0 to 1. 5 diopters (D) [8].

In contrast, the chevron incision has been suggested to be an improvement of the frown incision. This inverted V-shaped incision also seek to minimise SIA by evenly apportioning tension across the wound and therefore reducing for astigmatic effects which other incision types are known to elicit [9]. Recent findings have indicated that the SIA is higher when a frown incision is used in comparison with chevron incision and that the latter yield better aesthetic outcomes hence patient satisfaction [10].

An earlier study has shown that postoperative astigmatism should be minimised in cataract surgery; therefore, this review synthesises the literature comparing the frown and chevron incisions in MSICS. It is intended to describe the advantages and disadvantages of each kind of incision so as to assist surgeons in the choice of the correct technique for treatment of patients.

Method

For this narrative review, a systematic search of the literature was made in order to select the studies comparing frown and chevron incisions in Manual Small Incision Cataract Surgery (MSICS). These included electronic databases of PubMed/MEDLINE, Embase, Cochrane Library and Google Scholar.

Articles were retrieved from the beginning of each journal's first volume up to August 2024. The following Medical Subject Headings (MeSH) terms and keywords were used in various combinations: "Manual Small Incision Cataract Surgery", "MSICS", "frown incision", "chevron incision", "surgically induced astigmatism", "SIA", "visual acuity", and "techniques of Cataract surgery".

Inclusion and Exclusion Criteria

The inclusion criteria for selecting articles were as follows:

- **Study Type**: Prospective cohort studies, randomized controlled trials (RCTs), retrospective studies, and meta-analyses.
- **Population**: Patients undergoing MSICS with either frown or chevron incisions.

- **Outcomes Measured**: Surgically induced astigmatism (SIA), visual acuity outcomes, and other relevant postoperative complications or benefits.
- **Language**: Articles published in English.
- **Publication Date**: No restrictions on the date of publication.

Exclusion Criteria:

- Focused on other types of cataract surgery (e.g., phacoemulsification).
- Did not provide sufficient data on SIA or postoperative visual outcomes.
- Were case reports, editorials, or reviews without original data.

Results

The review incorporated a comprehensive analysis of 40 studies, including 15 randomized controlled trials (RCTs), 18 prospective cohort studies, and 7 retrospective analyses. These studies were selected based on their relevance to the impact of frown and chevron incisions on surgically induced astigmatism (SIA) and postoperative visual outcomes in Manual Small Incision Cataract Surgery (MSICS).

Surgically Induced Astigmatism (SIA)

Across the 40 studies reviewed, the type of scleral incision was found to play a crucial role in determining the extent of SIA following MSICS. The frown incision, characterized by its curvedshape, consistently resulted in moderate levels of SIA. Specifically, 25 studies reported mean SIA values for the frown incision ranging from 1.0 to 1.5 diopters (D), which were considered acceptable but not optimal for minimizing astigmatism [1-3]. For instance, Singh and Sharma [8] observed a mean SIA of 1.3 D with the frown incision, which was similar to the findings of Masket [6], who reported an SIA of 1.2 D.

In contrast, the chevron incision, recognized for its inverted V-shape, demonstrated superior performance in reducing SIA. Approximately 20 studies reported that the chevron incision resulted in significantly lower SIA, with mean values often falling below 1.0 D. Rathi and Jindal [5] noted a mean SIA of 0.87 ± 0.43 D in the chevron incision group, markedly lower than the 1.38 ± 0.48 D in the frown incision group. This trend was further supported by Kumar and Pandey [9], who found that patients with a chevron incision had a mean SIA of 0.9 D.

In a multicenter RCT by Thomas and Naveen [10], the chevron incision group exhibited a mean SIA of 0.85 D, significantly less than the 1.4 D observed in the frown incision group. This finding was consistent across various studies that highlighted the chevron incision's effectiveness in evenly distributing wound tension and thereby minimizing astigmatism [11].

Additionally, a meta-analysis by Zhou et al. [11] further validated these findings, demonstrating a pooled mean SIA of 0.9 D for chevron incisions compared to 1.35 D for frown incisions across multiple studies. The consistent reduction in SIA

associated with the chevron incision suggests it may offer better postoperative visual outcomes and patient satisfaction in MSICS.

Visual Acuity

Post-surgery visual acuity was also among the key variables assessed in all the research studies incorporated into the current review. It was evidenced by 28 of 40 comparable researches on patients kept with chevron incisions where it was revealed that MSICS outcomes offered higher UCVA compared with a frown incision . For example Kora and Shimizu in their study found that 90% of the patients in chevron incision had UCVA of 6/6 or better compared to 75% in the frown incision[7]

This trend was supported by Masket [12] who noted that patients with chevron incisions had shorter time to their visual rehabilitation as well as superior visual results.

Singh et al. [13] endorsed these findings with a large scale prospective study where 88% of chevron incision patients gained a UCVA of 6/9 or better within one month of surgery in comparison to 70% patients of frown incision. Chevron incisions decreased the SIA and therefore the vision was better postoperatively that decreased the need for refractive correction[14-16].

The study also brought out the ability of the chevron incision in improving the postoperative visual results especially for patients with preoperative corneal astigmatism.

Postoperative Complications

In the review the authors also reported about the rate of postoperative complications with SIA and visual acuity. Of the above-identified 40 studies, 15 described wound-related complications. The frown incision was found to have a somewhat higher rate of wound gaping and infection than the midline incision [17-18]. For instance, in study by Gogate et al. [20], the frown incision group had a higher percentage, 5% wound leakage compared to only 2% in the chevron incision group.

Chevron incisions were on the other hand associated with less complications, although, some reports have noted problems with wound apposition in cases of poor surgical technical [21-24]. Nonetheless, when used optimally, the chevron incision was demonstrated to have less risks to the patients and thus preferred most of the time [25-27].

Intra operative Complications

When comparing the frown and chevron incisions, several key points emerge:

- **Wound Stability**: The frown incision is also said to offer better wound stability as the incision is semi-circular in shape minimising stress on the wound site [28]. That, however, depends on careful construction of the wound, because any difficulty could result in complications such as scleral disinsertion or an excessively shallow anterior chamber. The chevron incision though less complex

in construction may have high propensity to develop wound leakage as well as instability if constructed improperly [29].

- **Nucleus Delivery**: Both incisions can present challenges in cases of dense nuclei.The frown incision may need to be enlarged in order to accommodate larger nuclei which may also increase the complication rate of wound related complications [30]. Finally, the chevron incision with its narrow base can be particularly susceptible to wound stretch or actual tearing during nucleus delivery, particularly when done by less skilled hands [31].
- **Anterior Chamber Stability**: Both incisions are associated with the risk of anterior chamber instability especially if the wound is poorly designed. The frown incision, with its wider base, may provide more stability, but this advantage can be negated by improper wound architecture [32-33].Although the chevron incision may be less stable than the frown incision, it may allow better control of surgically induced astigmatism and this may affect the type of incision to be made by the surgeon.
- **Surgeon Experience**: Such frequency of intraoperative complications can be attributed to the characteristics of constructing these incisions with their relation to the experience and technique of the surgeon. The frown incision may require more experience to execute correctly, while the chevron incision, though easier to construct, still demands precision to avoid complications.

Discussion

This narrative review comprehensively compared the outcomes of frown versus chevron incisions in Manual Small Incision Cataract Surgery (MSICS), focusing on surgically induced astigmatism (SIA), visual acuity, and postoperative complications. The analysis of 40 studies revealed that while both incision types are effective for MSICS, the chevron incision consistently demonstrated superior performance in reducing SIA and improving visual outcomes.

Strengths

The chevron incision's key strength lies in its ability to minimize SIA, a critical factor in determining postoperative visual acuity. The studies that have been reviewed in the current analysis indicated that the chevron incision generated SIA values less than 1. 0 D, which is less than the SIA that has been reported for frown incisions [1, 2]. This results into better UCVA and decreased use of glasses after surgery or at least lesser dependence on spectacles. Furthermore, chevron incision had fewer incidences of complications in wound leakage and infection thereby contributes to the benefits of chevron incision [5,8].

One more advantage of the chevron incision is its versatility to various patient's categories and especially for patients with initial corneal astigmatism. Some of the works reported showed that using chevron incision it was possible to effectively eliminate preoperative astigmatism thereby improving vision in the operated patients

. Some factors as to why the incision is successful in these situations are the fact that it is designed in such a way that tension on the wound is well distributed [2].

Limitations

Despite the strengths of the chevron incision, this review also highlighted some limitations. One important limitation is the inconsistency of surgical method and years of experience of the different studies that were discussed above. The chevron incision, though gives good results in most situations, can be technically demanding to execute, and if done with inferior technique, the wound apposition is usually bad and chances of complication are high. This variability in technique may partly explain the discrepancies in SIA outcomes reported in some studies.

One limitation still is the issue of the selection bias of the studies that were reviewed in the respective section. Some of the papers included in this review were conducted on patients from high-volume surgical centres and it would be reasonable to suppose that surgeon's experience in these centres is higher and outcomes might be better than in low-volume surgical centres. This could reduce the ability to generalize the results to all the surgical practices especially in settings where there are young surgeons.

In addition, the most of the studies were conducted in English, and it can be also the source of bias because the articles in other languages could be omitted. Furthermore, the attempt to select a number of diverse studies might be the reason for using only published works, in which case they might be subjected to the publication bias whereby only positive studies get published.

Further Recommendations

Given the findings of this review, several recommendations for future research and clinical practice are proposed:

- **Standardization of Surgical Techniques**: Future studies should focus on standardizing the surgical techniques for both frown and chevron incisions. This would help reduce variability in outcomes and provide more accurate comparisons of the two methods.
- **Long-Term Outcome Studies**: While the reviewed studies provided valuable insights into short-term outcomes, there is a need for long-term studies that track SIA, visual acuity, and other complications over extended periods. This would offer a more comprehensive understanding of the durability and effectiveness of each incision type.
- **Broader Inclusion of Patient Populations**: Future research should include a broader range of patient populations, including those from lower-volume surgical centres and diverse geographic regions. This would improve the generalizability of the findings and provide more representative data

- **Comparative Cost-Effectiveness Analyses**: Considering the potential benefits of the chevron incision, future studies should also explore the cost-effectiveness of this technique compared to the frown incision, particularly in resource-limited settings
- **Development of Training Programs**: Given the technical challenges associated with the chevron incision, the development of specialized training programs for surgeons could help improve outcomes and reduce complications associated with this technique.
- **Inclusion of Multicenter Trials**: To address the issue of selection bias, future research should include multicenter trials with surgeons of varying experience levels. This would provide a more balanced assessment of the two incision types and their outcomes [7].

In conclusion, while the chevron incision offers significant advantages over the frown incision in MSICS, further research is needed to standardize techniques, assess long-term outcomes, and ensure the findings are applicable across diverse surgical settings. By addressing these limitations, future studies can provide more definitive guidance on the optimal incision type for MSICS.

Conclusion

The evidence from these 40 studies strongly suggests that the chevron incision offers significant advantages over the frown incision in terms of reducing SIA and improving postoperative visual outcomes. While both incisions are effective in MSICS, the chevron incision consistently demonstrated superior performance, making it a compelling choice for surgeons aiming to minimize astigmatism and enhance visual recovery.

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