Changes and Influencing Factors of Postoperative Vaulting in Intraocular Lens Implantation Surgery

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**Abstract**

Posterior chamber intraocular lens implantation is currently one of the popular myopia surgeries. However, postoperative vaulting may affect the visual and quality of life of patients. This article aims to study the changes in vaulting after posterior chamber intraocular lens implantation and its influencing factors. By reviewing relevant literature, the causes of postoperative vaulting, the changes in postoperative vaulting, and the influencing factors were analyzed. The results showed that postoperative vaulting may be related to various factors, including surgical techniques, lens selection, patient age, and axial length. In terms of surgical techniques, reasonable incisions and appropriate lens positioning can reduce the risk of postoperative vaulting. In terms of lens selection, the use of modern artificial lenses can improve surgical outcomes and patient satisfaction. Additionally, patient age and axial length may also influence the occurrence of postoperative vaulting. Therefore, doctors need to consider these factors comprehensively and develop individualized surgical plans to reduce the incidence of postoperative vaulting and improve treatment outcomes.

**Keywords**

Intraocular lens, vaulting, postoperative, myopia, influencing factors

1. Introduction

Artificial lens implantation is one of the commonly used surgical methods for treating myopia and has been widely used in clinical practice. This surgery involves implanting artificial lenses into the eyes to restore vision and improve the quality of life for patients. However, despite the high success rate of the surgery, some patients may experience postoperative vaulting. Vaulting refers to an abnormal change in the position of the intraocular lens after surgery, resulting in an increased distance between the lens and the natural lens. This change may lead to poor visual acuity after surgery and increase the risk of other complications. Therefore, understanding the changes and influencing factors of postoperative vaulting is of great significance for improving surgical techniques and preventing and managing vaulting.

2. Changes in Postoperative Vaulting and Influencing Factors in Posterior Chamber Intraocular Lens Implantation

1) Crystalline instability may be one of the important causes of postoperative vaulting. After the patient undergoes crystalline implantation surgery, the position of the crystal may shift or rotate [1]. This abnormal position of the crystal can cause changes in the shape of the eyeball, leading to postoperative vaulting. Crystalline instability may be related to surgical techniques such as the size and location of the incision, as well as the method of crystal-
line fixation. If the surgical procedure is inaccurate or the fixation is not secure, the crystal is prone to instability, increasing the risk of postoperative vaulting. Crystalline instability may be caused by multiple factors. Firstly, the stability of the incision and crystalline sac during surgery plays a crucial role in the position of the crystal. Proper and precise incisions help ensure the proper position of the crystal and reduce the risk of postoperative vaulting [2]. Secondly, the selection and design of the crystal may also affect its stability. Different types, materials, and sizes of artificial crystals have different difficulty and stability in implantation. Therefore, these factors need to be considered by doctors when choosing the appropriate crystal for the patient. Lastly, the technique of crystalline fixation during the surgery is also an important factor affecting postoperative vaulting. Various methods can be used for the fixation of artificial crystals, such as haptic fixation or iris suture. Choosing the appropriate technique for crystalline fixation is crucial for ensuring the stability of the crystal's position.

2) Some patients may have congenital or acquired structural problems, such as weak sclera or corneal deformation, which may also increase the risk of postoperative vaulting. The sclera is the outer layer of the eyeball and plays a role in protecting the internal structures of the eyeball. If the sclera is weak or has structural abnormalities, it increases the possibility of changes in eyeball shape after crystalline implantation, resulting in vaulting. Additionally, corneal deformation can also cause postoperative vaulting. The cornea is the transparent tissue on the surface of the eyeball, and its normal curvature is important for maintaining the shape of the eyeball. If the cornea has irregular curvature or deformations caused by diseases, it increases the risk of postoperative vaulting. Weak sclera can be caused by various factors, including genetic factors, ocular trauma, and surgical procedures. When a patient has weak sclera, the sclera may not provide sufficient support after crystalline implantation surgery, leading to abnormal changes in the position of the crystal and the occurrence of vaulting. Furthermore, some congenital or acquired corneal diseases, such as keratoconus, can also cause irregular curvature of the cornea, increasing the risk of postoperative vaulting.

3) Postoperative inflammation reactions may also be one of the causes of postoperative vaulting. After crystalline implantation surgery, there may be inflammation reactions in the eye tissues. If the inflammation reaction is excessive or lasts for a long time, it can cause edema and fibrosis of the eye tissues, leading to postoperative vaulting [4]. The severity of postoperative inflammation reactions may be related to individual differences in patients and surgical procedures. The occurrence of postoperative inflammation reactions is closely related to surgical trauma and tissue damage. Postoperative inflammation reactions are usually normal physiological responses, but excessive or prolonged inflammation reactions can have negative effects on eye tissues. Inflammation can cause edema, vascular dilation, and fibrosis of the eye tissues, affecting the stability and normal position of the crystal [5]. Therefore, meticulous surgical procedures and control and treatment of postoperative inflammation are very important to reduce the risk of postoperative vaulting. By studying these causes, doctors can better understand the mechanism of postoperative vaulting, develop more accurate prevention and treatment strategies, and reduce the risk of vaulting, thereby improving surgical outcomes and visual recovery for patients.

3. Changes in Postoperative Vaulting

The postoperative change in corneal vaulting has been a widely discussed issue in the field of ophthalmic surgery in recent years. Postoperative corneal vaulting refers to an increase in the horizontal diameter of the anterior part of the eyeball after myopia surgery or other eye surgeries, resulting in visual distortion and astigmatic symptoms [6]. Understanding the changes in postoperative corneal vaulting is of great significance for selecting appropriate surgical methods, preventing complications, and optimizing surgical outcomes.

The postoperative change in corneal vaulting is a relatively complex and variable issue. In different studies, there have been inconsistent results regarding the change in corneal vaulting after surgery. Some studies have shown that the degree of corneal vaulting increases in the short term after surgery, but it may gradually decrease during long-term follow-up.

The increased degree of corneal vaulting in the short term after surgery may be related to the healing and adaptation processes of the eye tissues. Immediately after the surgery, the eye tissues may experience edema and inflammatory reactions, leading to changes in the shape of the eyeball and resulting in corneal vaulting. In addition, changes in intraocular pressure after surgery may also have a certain impact on corneal vaulting [7]. Changes in intraocular pressure can cause instability in the position of the lens, thus triggering corneal vaulting.

However, over time, the degree of corneal vaulting may gradually decrease. This can be attributed to the gradual stabilization of eye tissues during the healing process and their adaptation to the changes brought about by intraocular lens implantation. Fibrosis and remodeling of the eye tissues after surgery may help stabilize the lens in a
more stable position and reduce the occurrence of corneal vaulting. In addition, the postoperative inflammatory reaction may gradually diminish, which also contributes to the reduction in corneal vaulting.

But, it needs to be clarified that there is currently no consensus on the changes in postoperative corneal vaulting. Different studies have used different follow-up times and evaluation methods, which may result in differences in the results. Furthermore, the degree and changes in corneal vaulting after surgery may also be influenced by other factors, such as surgical techniques, patients' ocular morphology, and overall health condition [8].

To better understand the changes in postoperative corneal vaulting, future research can involve larger sample sizes and employ long-term follow-up and standardized assessment methods to obtain more reliable results. By tracking the process of changes in patients' ocular morphology and considering other relevant factors, a better understanding of the development of corneal vaulting can be achieved. This will help formulate more effective strategies for prevention and treatment, thereby improving the long-term outcomes and quality of life for patients undergoing surgery.

Currently, some studies have also explored the risk factors and interventions related to postoperative corneal vaulting. For example, preoperative evaluation of ocular morphology and the selection of appropriate intraocular lenses can reduce the risk of postoperative corneal vaulting. Furthermore, improvements in surgical techniques and the selection of appropriate surgical methods can also play a positive role in the occurrence of corneal vaulting. However, more research is still needed to validate the effectiveness of these risk factors and interventions.

In conclusion, the changes in postoperative corneal vaulting are a complex and variable issue. Despite some inconsistent results, a better understanding of the development of corneal vaulting can be achieved through further research and evaluation, leading to the formulation of corresponding strategies for prevention and treatment. This will help improve the outcomes of ophthalmic surgery and enhance patients' quality of life.

4. Factors Influencing Postoperative Vaulting

1) Surgical technique is one of the important factors influencing postoperative vaulting. Reasonable incision selection, appropriate lens position, and corneal cutting techniques can reduce the risk of postoperative vaulting. Studies have shown that the location and size of the incision are associated with the occurrence of postoperative vaulting. Smaller incisions may result in less tissue damage, which is beneficial for the stability of the eyeball structure. The depth and location of corneal cutting may also affect the degree of vaulting. Therefore, the surgeon's skill and technical experience during the surgery are crucial in preventing and treating postoperative vaulting.

Improvement in surgical technique can be achieved through continuous enhancement of doctors' technical abilities and training. For example, the use of advanced surgical equipment and techniques can improve the accuracy and controllability of the surgery, thereby reducing damage to the eyeball structure. In addition, establishing standardized surgical procedures and operating specifications in clinical practice can also reduce the risk of postoperative vaulting.

2) The choice of intraocular lens also has an impact on postoperative vaulting. Modern artificial lenses have better stability and adaptability, which can improve surgical outcomes and patient satisfaction. Some studies have found that using foldable intraocular lenses can reduce the risk of postoperative vaulting compared to rigid lenses. Foldable intraocular lenses have soft material characteristics, allowing them to better adapt to changes in eyeball shape and reduce the likelihood of postoperative vaulting [9].

When selecting intraocular lenses, doctors should take into account their material characteristics, adaptability, and long-term effects. Different patients have different eyeball shapes and requirements, so personalized selection is essential. Doctors can choose the most suitable type of intraocular lens based on indicators such as the patient's axial length and refractive error, combined with clinical experience and the latest research results.

3) Patient age and axial length may also affect the occurrence of postoperative vaulting. Studies have shown that older patients are more prone to vaulting after surgery. This may be related to the weakened elasticity and reduced adaptability of eye tissues in older patients. As age increases, the elasticity of eye tissues decreases, making changes in eyeball shape more likely, thereby increasing the risk of postoperative vaulting.

In addition, longer axial length is also associated with postoperative vaulting. Patients with longer axial length may have greater differences in refractive error, which can lead to instability of the lens position within the eye, resulting in vaulting. Therefore, it is necessary to evaluate the patient's axial length before surgery and adopt appropriate surgical strategies and intraocular lens selection [10].

It should be noted that the above factors may interact with each other in their influence on postoperative vaulting. Therefore, doctors need to consider multiple factors comprehensively and develop individualized surgical plans.
before the surgery. Close attention should also be paid to patients' recovery process after surgery, and timely assessment and management of postoperative vaulting. Early detection and intervention can effectively reduce the degree of postoperative vaulting and improve the long-term outcomes of the surgery and the visual quality of patients.

5. Conclusion and Outlook

Posterior capsule opacification (PCO) is one of the common complications of intraocular lens implantation surgery. This complication can have a negative impact on the patient's visual function and quality of life. In order to reduce the incidence of PCO and improve surgical outcomes, a series of measures need to be taken.

Firstly, proper surgical technique is crucial in preventing PCO. During surgery, appropriate incision size and location should be chosen to minimize damage to the ocular tissues. Adequate lens selection and corneal incisions should also be performed to ensure the stability of the lens within the eye. These measures can reduce the risk of PCO.

Secondly, the choice of the intraocular lens is also important. Currently, there are various types of intraocular lenses available. Studies have shown that certain foldable intraocular lenses have better stability and adaptability compared to rigid lenses, which can lower the risk of PCO. Therefore, personalized selection of the intraocular lens based on the patient's needs and ocular condition is necessary.

Thirdly, the patient's age and axial length may also affect the occurrence of PCO. Older patients and those with longer axial length are more prone to develop PCO. This may be related to the decreased elasticity and adaptive ability of ocular tissues in older patients, as well as the instability of lens position caused by longer axial length. Therefore, the patient's age and axial length should be fully considered by doctors during assessment and surgical planning.

However, there is still considerable controversy regarding the variation and influencing factors of PCO. Future research can focus on several aspects to further improve surgical outcomes, reduce the incidence of PCO, and enhance the patient's quality of life.

Firstly, innovative and improved surgical techniques need to be explored. Although proper surgical techniques can reduce the risk of PCO, there is still room for improvement. For example, more precise surgical instruments and novel surgical methods can be employed to minimize damage to ocular tissues, thereby enhancing surgical safety and success rates. Additionally, new technologies such as robot-assisted surgery can be integrated to achieve more precise surgical procedures, further reducing the occurrence of complications.

Secondly, the development of intraocular lenses is also an important direction. Although multiple types of intraocular lenses exist, there is still room for improvement and refinement. Future research can focus on developing more tailored and personalized intraocular lenses based on different patient conditions and needs. These intraocular lenses can possess better stability, adaptability, and biocompatibility, thus further reducing the incidence of PCO and improving long-term surgical outcomes.

Thirdly, a deeper understanding of the pathogenesis and influencing factors of PCO is crucial. Despite existing studies on factors such as age and axial length, many mechanisms and factors remain unknown. In future research, comprehensive interdisciplinary approaches such as clinical observation, molecular biology, and histology can be employed to gain insight into the formation mechanism of PCO and identify more influencing factors. This will provide a more scientific basis for the prevention and treatment of PCO.

Lastly, further improvements are needed in the prevention and treatment strategies for PCO. Based on a better understanding of the pathogenesis and influencing factors of PCO, more individualized and effective preventive and treatment approaches can be developed for different situations and stages. This includes refining preoperative assessment, optimizing surgical techniques, improving postoperative rehabilitation and follow-up, among other aspects. By continuously improving these strategies, the incidence of PCO can be reduced, and the patient's visual function and quality of life can be enhanced.

With continued research efforts, it is hoped that surgical outcomes can be further improved, the occurrence of PCO can be reduced, and the patient's quality of life can be enhanced.

References


