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Complex Eyelid Repair Surgery: Standardization of Surgical Protocols and Clinical Efficacy Verification

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Abstract: *This study focuses on the field of complex eyelid repair surgery, aiming to develop and validate a standardized surgical protocol to enhance clinical outcomes. The research addresses the significant issues in current surgical practices, such as the lack of unified standards and the resultant instability in surgical efficacy and postoperative complications. Through a prospective cohort study involving 150 cases, two key surgical procedures—"combined brow lift and upper eyelid muscle adjustment" and "arcus marginalis release with fat grafting"—were evaluated. The results demonstrated substantial improvements in surgical success rates, patient satisfaction, and reduced complication rates. This study not only fills the gap in standardized protocols for complex eyelid repair but also provides a valuable reference for the industry's standardized development.*

Keywords: *Complex eyelid repair surgery; Standardized surgical protocol; Clinical efficacy; Patient satisfaction; Complication reduction*

1. Introduction

1.1 Research Background

Eyelid repair surgery is a crucial subset of plastic and cosmetic surgery, characterized by the delicate structure and vital function of the eye. The complexity lies in the need to balance aesthetics and functionality during repair. However, existing surgical practices for complex eyelid repair face several challenges. The absence of a unified standardized protocol leads to inconsistent surgical outcomes and frequent postoperative complications. These issues not only affect the repair efficacy but also hinder the industry's development. Therefore, establishing a scientific and standardized surgical protocol and verifying its clinical stability is of great significance for improving surgical success rates and regulating industry practices.

1.2 Research Objectives

This study aims to analyze the current state of complex eyelid repair surgery, develop a standardized surgical protocol, and validate its clinical efficacy through case studies. The research focuses on common procedures such as multiple failed blepharoplasty repairs and lower eyelid bags (arcus marginalis release and tear trough filling). By proposing optimized solutions, this study seeks to provide replicable operational guidelines for clinical practice.

1.3 Research Significance

This study is pioneering in developing a standardized protocol for complex eyelid repair surgery, offering scientific evidence and operational guidelines for the plastic and cosmetic surgery industry. By verifying the clinical efficacy of procedures like "combined brow lift and upper eyelid muscle adjustment" and "arcus marginalis release with fat grafting," this study can effectively enhance surgical success rates, reduce complications, and promote the industry's standardized development. It holds significant clinical application value and social implications.

2. Definition, Classification, and Existing Issues of Complex Eyelid Repair Surgery

2.1 Definition and Classification of Complex Eyelid Repair Surgery

Complex eyelid repair surgery refers to the surgical procedures for repairing and reconstructing

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eyelid deformities caused by congenital defects, trauma, surgical failures, or natural aging. These surgeries aim to restore both the normal appearance and function of the eye and require high technical expertise and experience. Specifically, complex eyelid repair surgeries include multiple failed blepharoplasty repairs, lower eyelid bags (arcus marginalis release and tear trough filling), eyelid scar repair, and functional eyelid repair. The former addresses issues like scar adhesion, unnatural crease lines, and ptosis; the latter focuses on problems such as protruding bags and sunken tear troughs.

2.2 Existing Problems in Current Surgical Practices

Despite the widespread application of complex eyelid repair surgeries in the field of plastic and cosmetic surgery, several issues persist. The lack of a unified standardized surgical protocol leads to significant variations in surgical methods among different surgeons, resulting in inconsistent outcomes. For example, the management of scar adhesion in multiple failed blepharoplasty repairs and the surgical steps and techniques for arcus marginalis release and tear trough filling lack standardized guidelines. This inconsistency often leads to complications such as unnatural crease lines, ptosis, and sunken tear troughs, which not only affect the patient's appearance but also have negative psychological impacts. Additionally, the long-term efficacy of complex eyelid repair surgeries is often not guaranteed, with potential complications like scar hypertrophy, infection, uneven fat absorption, and ectropion. These issues contribute to a generally low patient satisfaction rate, with many patients experiencing new problems post-surgery and decreased trust in doctors and hospitals.

3. Standardization of Surgical Protocols for Complex Eyelid Repair Surgery

3.1 Standardized Protocol for Multiple Failed Blepharoplasty Repairs

Preoperative assessment is a critical step, involving detailed medical history collection (including previous surgical history, allergies, and medication use), comprehensive ophthalmic examination (evaluating eyelid skin elasticity, scar conditions, and crease line position and width), and psychological evaluation to understand the patient's expectations and ensure realistic surgical goals. The surgical steps include local infiltration anesthesia, rational incision design, meticulous scar management, crease line adjustment, and fine suturing with absorbable sutures. Postoperative care comprises cold compresses, antibiotic prophylaxis, and anti-inflammatory medications to reduce swelling, with regular follow-ups to monitor recovery. In 150 cases, the success rate for scar adhesion management exceeded 90%, and patient satisfaction with the crease line reached over 85%.(See Table 1 below)

Table 1 Preoperative assessment

Surgical Procedure Steps	**Content**
Anesthesia Method	Local Infiltration Anesthesia
Incision Design	Rational Incision Design
Scar Management	Delicate Scar Management
Double Eyelid Line Adjustment	Adjust Double Eyelid Line
Suture Method	Use of Absorbable Sutures for Delicate Suturing

3.2 Standardized Protocol for Lower Eyelid Bags (Arcus Marginalis Release and Tear Trough Filling)

Similar to the previous protocol, preoperative preparation is essential, including medical history collection, ophthalmic examination, and psychological evaluation. The surgical steps involve local infiltration anesthesia, incision design, arcus marginalis release, fat grafting, and fine suturing. Postoperative observation includes cold compresses, medication use, and regular follow-ups. In 150 cases, the success rate for arcus marginalis release exceeded 95%, and the improvement rate for tear trough depression reached over 90%.[1]

3.3 Optimization and Refinement of Standardized Protocols

Analysis of 150 complex eyelid repair surgery cases revealed some postoperative issues, such as scar adhesion and insufficient improvement in tear trough depression. To address these problems, optimization measures were implemented. For scar adhesion management, more delicate dissection techniques were used during surgery to avoid excessive traction, and postoperative anti-scar medications were administered to reduce scar formation. For tear trough depression, uniform fat

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grafting during arcus marginalis release and regular postoperative massage to promote fat survival were ensured. Additionally, enhanced postoperative care instructions were provided to ensure strict patient compliance, reducing complications. These measures further improved the standardization of complex eyelid repair surgeries, ensuring stable surgical outcomes and patient satisfaction.

4. Clinical Efficacy Verification

4.1 Research Design and Methods

This study employed a prospective cohort design to verify the efficacy and stability of the standardized surgical protocols for complex eyelid repair. The sample included 150 patients who underwent complex eyelid repair surgeries at Taian Eighty-Eight Hospital and several private plastic surgery hospitals in Beijing and Shanghai from January 2023 to December 2024. The patients comprised 30 males and 120 females, aged between 20 and 65 years. All patients underwent detailed preoperative assessments, including medical history collection, ophthalmic examination, and psychological evaluation, to ensure accurate surgical indications and realistic patient expectations.

The patients were divided into two groups: the combined brow lift and upper eyelid muscle adjustment group (75 patients, 15 males and 60 females, with an average age of 45 years), and the arcus marginalis release with fat grafting group (75 patients, 15 males and 60 females, with an average age of 48 years). The evaluation indicators included patient satisfaction with repair outcomes, complication incidence, and pre- and postoperative comparisons. Patient satisfaction was assessed using the Visual Analog Scale (VAS) at 1, 3, and 6 months post-surgery, with a maximum score of 10. Complication incidence was recorded within one month post-surgery, including infections, scar hypertrophy, and asymmetry. Pre- and postoperative comparisons were made using photographs to evaluate the improvement in eyelid appearance.

4.2 Clinical Efficacy Verification of the Combined Brow Lift and Upper Eyelid Muscle Adjustment Procedure

The combined brow lift and upper eyelid muscle adjustment procedure is primarily used to address issues such as upper eyelid ptosis, brow ptosis, and unnatural crease lines. In this study, 75 patients underwent this procedure, with VAS scores of 8.2 ± 0.8 at one month, 8.5 ± 0.7 at three months, and 8.7 ± 0.6 at six months post-surgery, indicating high patient satisfaction. Pre- and postoperative photograph comparisons showed significant improvements in upper eyelid ptosis and brow ptosis, with more natural and aesthetically pleasing crease lines.(See Table 2 below)

Table 2 Postoperative photograph comparisons

Item	**Content**
Procedure Name	Combined brow lift and upper eyelid muscle adjustment
Applicable Issues	Upper eyelid ptosis, brow ptosis, unnatural crease lines
Sample Size	75 cases
Postoperative VAS Scores	
1 month post-surgery	8.2 ± 0.8
3 months post-surgery	8.5 ± 0.7
6 months post-surgery	8.7 ± 0.6

In terms of complications, within one month post-surgery, only five cases (6.7%) exhibited mild scar hypertrophy, all of which were alleviated with medication. No infections or other severe complications were observed. This indicates that the combined brow lift and upper eyelid muscle adjustment procedure is highly stable and safe in improving eyelid defects.

4.3 Clinical Efficacy Verification of the Arcus Marginalis Release with Fat Grafting Procedure

The arcus marginalis release with fat grafting procedure is mainly used for lower eyelid bag repair and tear trough filling. In this study, 75 patients underwent this procedure, with VAS scores of 8.0 ± 0.9 at one month, 8.3 ± 0.8 at three months, and 8.5 ± 0.7 at six months post-surgery. Postoperative photograph comparisons showed significant improvements in lower eyelid bags and tear troughs, resulting in a more youthful and natural eyelid appearance.[2]

In terms of complications, within one month post-surgery, only three cases (4.0%) exhibited mild uneven fat absorption, which was improved with massage and medication. No infections or other severe complications were observed. This indicates that the arcus marginalis release with fat grafting

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procedure has significant advantages in enhancing repair efficacy stability and reducing complication incidence.

4.4 Comparison and Analysis of Different Procedures

Comparative analysis of the clinical efficacy of the two procedures revealed that at six months post-surgery, the VAS score for the combined brow lift and upper eyelid muscle adjustment group was 8.7 ± 0.6, while that for the arcus marginalis release with fat grafting group was 8.5 ± 0.7. Both groups demonstrated high patient satisfaction, with the former slightly higher. In terms of complication incidence, the combined brow lift and upper eyelid muscle adjustment group had a rate of 6.7%, while the arcus marginalis release with fat grafting group had a rate of 4.0%.(See Table 3 below)

Table 3 Clinical efficacy

Item	**Combined Brow Lift and Upper Eyelid Muscle Adjustment Group**	**Arcus Marginalis Release with Fat Grafting Group**
VAS Score at 6 months post-surgery	8.7 ± 0.6	8.5 ± 0.7
Patient Satisfaction	High (slightly higher than the other group)	High
Complication Incidence	6.7%	4.0%

Regarding the applicability of different procedures for eyelid defect repair, the combined brow lift and upper eyelid muscle adjustment procedure is more suitable for correcting upper eyelid ptosis, brow ptosis, and unnatural crease lines, while the arcus marginalis release with fat grafting procedure excels in lower eyelid bag repair and tear trough filling. Both procedures exhibit high clinical efficacy stability and low complication incidence, providing important reference for clinical practice.

5. Discussion

5.1 Significance of Standardized Surgical Protocols for Complex Eyelid Repair

The development of standardized surgical protocols for complex eyelid repair is crucial for enhancing surgical outcome stability and reducing complication incidence. In this study, analysis of clinical data from 150 patients demonstrated that standardized protocols significantly increased surgical success rates and patient satisfaction. Specifically, the combined brow lift and upper eyelid muscle adjustment procedure and the arcus marginalis release with fat grafting procedure achieved patient satisfaction scores above 8.5 at six months post-surgery, with complication incidence rates of only 6.7% and 4.0%, respectively. This indicates that standardized protocols can effectively minimize surgical risks caused by individual differences and technical non-standardization, ensuring stable and predictable surgical outcomes.[3]

Moreover, the promotion of standardized protocols holds profound significance for the industry's standardized development. Currently, significant individual differences exist in the clinical practice of complex eyelid repair surgeries, lacking unified operational standards. This status quo not only affects the overall surgical efficacy but also poses unnecessary risks to patients. By establishing standardized protocols, clear operational guidelines can be provided for surgeons to regulate surgical steps and reduce complications caused by technical variations. Additionally, the widespread adoption of standardized protocols can enhance the industry's technical level and service quality, promoting the healthy development of the plastic and cosmetic surgery industry.

5.2 Significance and Limitations of Clinical Efficacy Verification

Clinical efficacy verification is an essential means of assessing procedure effectiveness and guiding clinical practice. In this study, the prospective cohort design was employed to systematically evaluate the clinical efficacy of the combined brow lift and upper eyelid muscle adjustment procedure and the arcus marginalis release with fat grafting procedure. The results showed that both procedures performed well in improving eyelid defects and enhancing repair efficacy stability, with low complication incidence. These data not only provide reliable references for clinical surgeons but also support the promotion of standardized protocols.

However, this study also has certain limitations. Firstly, the relatively small sample size of 150 cases may affect the generalizability of the study results. Secondly, the observation period was relatively short, lasting only six months, which may not be comprehensive enough for assessing

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long-term effects. For instance, the long-term absorption of fat grafts and scar evolution require longer follow-up periods for observation. Additionally, the study did not involve long-term assessments of patients' psychological states and quality of life, which are directions for future research to further improve.

5.3 Future Research Directions

Firstly, the application of new technologies is a crucial pathway for enhancing surgical efficacy. With the continuous advancement of medical technology, new materials and techniques are constantly emerging, such as bioabsorbable materials and laser technology. The application of these new technologies in complex eyelid repair has the potential to further improve surgical efficacy stability and patient satisfaction. For example, bioabsorbable materials can reduce the foreign body sensation and complication risks associated with traditional materials, while laser technology can play a significant role in scar repair and tissue remodeling.

Secondly, long-term effect observation is key to assessing procedure effectiveness. Future research should extend follow-up periods to track patients for one year, two years, or even longer, to comprehensively evaluate surgical long-term effects. This should include not only aesthetic improvements but also functional recovery, complication incidence, as well as patients' psychological states and quality of life.

Lastly, multicenter studies and big data analysis are also important directions for future research. Through multicenter collaboration, larger sample sizes can be achieved, enhancing the generalizability and reliability of research results. Meanwhile, big data analysis technology can be utilized to deeply mine vast amounts of clinical data, identify potential patterns and issues, and provide scientific basis for the optimization of standardized protocols.

6. Conclusion

6.1 Research Summary

This study focused on complex eyelid repair surgery, systematically developing standardized surgical protocols and verifying their stability and reliability through clinical data. The study covered two procedures—“combined brow lift and upper eyelid muscle adjustment” and “arcus marginalis release with fat grafting”—and conducted a prospective cohort study on 150 patients to comprehensively evaluate the clinical efficacy of these procedures. The results showed that the implementation of standardized protocols significantly enhanced surgical outcome stability. At six months post-surgery, the patient satisfaction score for the combined brow lift and upper eyelid muscle adjustment group was 8.7 ± 0.6, while that for the arcus marginalis release with fat grafting group was 8.5 ± 0.7, both indicating high patient satisfaction. Additionally, the complication incidence rates for both procedures were low, at 6.7% and 4.0%, respectively. Moreover, the study compared the efficacy of the two procedures, clarifying their respective advantages and applicable scopes, providing important references for clinical surgeons when selecting procedures.

6.2 Research Contributions and Innovations

This study made significant contributions to the field of complex eyelid repair. Firstly, it systematically developed standardized surgical protocols for complex eyelid repair, covering preoperative assessment, surgical steps, and postoperative care. The implementation of these protocols significantly enhanced surgical outcome stability and patient satisfaction, providing scientific evidence for clinical practice. Secondly, through a prospective cohort study on 150 patients, the clinical efficacy of the “combined brow lift and upper eyelid muscle adjustment” and “arcus marginalis release with fat grafting” procedures was systematically verified. The results showed that both procedures performed well in improving eyelid defects and enhancing repair efficacy stability, with low complication incidence. Lastly, the study provided a detailed comparison of the efficacy of the two procedures, clarifying their respective advantages and applicable scopes, offering important references for clinical surgeons when selecting procedures. This helps to increase surgical success rates and patient satisfaction.

6.3 Implications for Industry Development

This study offers important theoretical and practical guidance for the field of complex eyelid repair, with profound implications for industry development. Firstly, the development and promotion of

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standardized protocols can reduce surgical risks caused by individual differences and technical non-standardization, enhancing the industry's technical level and service quality. This not only improves patient satisfaction but also promotes the healthy development of the plastic and cosmetic surgery industry. Secondly, the optimization measures proposed in this study, such as meticulous scar management and fat grafting techniques, provide new ideas and methods for complex eyelid repair, further enhancing surgical efficacy. Additionally, the systematic verification and comparative analysis of the clinical efficacy of the two procedures provide important references for clinical surgeons when selecting procedures. This helps to increase surgical success rates, reduce complications, and improve patient satisfaction. Lastly, the study points out future research directions in the development of standardized protocols and clinical efficacy verification for complex eyelid repair procedures, such as the application of new technologies and long-term effect observation. This provides clear directions for future research to further refine standardized protocols and promote industry development.

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