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Multimodal Facial Rejuvenation: Personalized Protocols and Safety Assessment

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Abstract

This study explores personalized multimodal protocols for facial rejuvenation and their safety assessment, aiming to guide clinical practice. A prospective study involving 200 patients was conducted, integrating techniques such as thread lifting, fat grafting, minimally invasive facelifts, and radiofrequency lipolysis. A personalized anti-aging protocol matching model was developed for individuals of different ages and skin conditions. Results indicate that the combination of thread lifting and radiofrequency lipolysis is suitable for patients aged 30-40, while fat grafting combined with mini-incision facelifts is effective for patients over 50, both demonstrating good safety and efficacy. The study also proposes practical guidelines for multimodal applications and future research directions, including the application of new technologies and long-term effect evaluation.

Keywords: facial rejuvenation, multimodal approach, personalized protocols, safety assessment, clinical practice, thread lifting, fat grafting, minimally invasive facelift, radiofrequency lipolysis, complications, postoperative care, long-term effects

1. Introduction

1.1 Research Background

With the rapid development of the socio-economy and the significant improvement of people's living standards, facial rejuvenation has become a hot topic in the field of aesthetic medicine. Facial aging is a complex biological process involving multiple factors such as changes in skin structure, collagen loss, alterations in fat distribution, and the formation of dynamic wrinkles. Traditional monotherapy anti-aging techniques (e.g., injectable aesthetics, laser therapy) have certain effects on improving some aging symptoms but are unable to comprehensively address facial aging issues. In recent years, thread lifting, fat grafting, minimally invasive facelifts, and radiofrequency lipolysis have been widely applied in the anti-aging field. Clinical practice has shown that the combined application of these techniques can achieve complementary advantages and enhance anti-aging effects. However, systematic research on multimodal applications is relatively scarce, lacking personalized anti-aging protocol matching models for individuals of different ages and skin conditions, as well as clear definitions of the safety boundaries of combined surgical procedures. This has to some extent restricted the standardized and precise development of clinical practice.

1.2 Research Significance

This study, focusing on personalized multimodal protocols and safety assessment for facial rejuvenation, holds significant theoretical and practical importance. From a theoretical perspective, by deeply exploring the mechanisms of combined anti-aging techniques, it enriches and perfects the theoretical system of facial rejuvenation, providing new ideas and methods for subsequent related research. In terms of practice, the construction of a personalized anti-aging protocol matching model can offer precise treatment guidance for

clinicians. It enables them to select the most suitable combined surgical procedures based on individual characteristics such as patients' ages and skin conditions, thereby improving treatment outcomes and patient satisfaction. Moreover, the analysis of the safety boundaries of combined surgical procedures helps reduce the risk of postoperative complications, ensures patients' medical safety, promotes the standardization and normalization of facial rejuvenation techniques, and facilitates the overall progress of the aesthetic medicine industry.

1.3 Research Objectives

This study aims to systematically analyze and summarize the clinical experience of multimodal facial rejuvenation, constructing a scientific and effective personalized anti-aging protocol matching model. It provides precise anti-aging treatment recommendations for individuals of different ages and skin conditions. Meanwhile, it thoroughly assesses the safety performance of common combined surgical procedures such as thread lifting + radiofrequency lipolysis and fat grafting + mini-incision facelifts in different populations, clarifying their safety boundaries. This provides a scientific basis for clinicians to reasonably select and apply combined surgical procedures in actual operations. It is expected to improve the overall efficacy and safety of facial rejuvenation treatments, promote the standardized and precise application of facial rejuvenation techniques in clinical practice, and meet people's demands for youthful and personalized beauty.

2. Theoretical Basis and Technical Principles

2.1 The Biology of Facial Aging

Facial aging is a complex biological process with physiological changes mainly reflected in the skin structure, collagen loss, and changes in fat distribution. The skin consists of the epidermis, dermis, and subcutaneous tissue. With increasing age, the renewal rate of keratinocytes in the epidermal layer slows down, the stratum corneum thickens, and the skin surface becomes rough. In the dermal layer, collagen and elastic fibers gradually decrease and undergo degeneration, while the content of hyaluronic acid declines. This leads to a loss of skin elasticity and water-retaining capacity, resulting in wrinkles and sagging. Additionally, the distribution and volume of facial fat change with age, with fat depositing in deeper tissues and causing facial contour ptosis. Areas such as the eye sockets and temples may become sunken. Frequent facial muscle activities can also lead to the formation of dynamic wrinkles, which gradually transform into static wrinkles as skin elasticity decreases. These physiological changes collectively form the biological basis of facial aging, providing a theoretical basis for the formulation of subsequent anti-aging protocols.

2.2 Principles of Anti-Aging Techniques

Regarding anti-aging techniques, thread lifting is a minimally invasive anti-aging technique. It involves implanting absorbable threads into the deep skin layer, utilizing the lifting effect of the threads to improve skin sagging and drooping. The threads form a supportive structure within the tissue, stimulating collagen production and enhancing skin firmness. This technique is suitable for patients with mild to moderate skin laxity and has the advantages of minimal trauma, quick recovery, and natural-looking effects. Fat grafting is a technique that involves extracting autologous fat from other parts of the body and transplanting it into the face. It fills in facial hollows, restoring facial fullness and a youthful appearance. Fat grafting not only improves facial contours but also stimulates collagen production, improving skin quality. Minimally invasive facelift surgery involves making incisions in inconspicuous areas of the face, removing excess skin, and lifting deeper tissues to achieve facial tightening and contour reshaping. It is suitable for patients with more severe facial aging. Radiofrequency lipolysis uses radiofrequency energy to act on fat tissue, promoting fat breakdown and metabolism. It also stimulates collagen contraction and neogenesis, achieving a skin-tightening effect. These anti-aging techniques each have their own advantages, and their combined application can achieve better anti-aging effects to meet the needs of different patients.

3. Research Methods and Data Collection

3.1 Research Design

This study employs a prospective cohort study design to systematically evaluate the clinical efficacy and safety of multimodal facial rejuvenation protocols. The study population consists of patients who underwent facial rejuvenation treatments at several private plastic surgery hospitals in Beijing and Shanghai from January 2023 to December 2024. Inclusion criteria include: individuals aged between 30 and 65 years old, with varying degrees of facial aging signs (such as skin sagging, wrinkles, changes in fat distribution, etc.) (Ugradar S, Isse N, Goldberg RA & Fodor P., 2020), and those who voluntarily participate in this study and sign an informed consent form. Exclusion criteria are: a history of facial surgery, severe systemic diseases, skin diseases or allergies, and those unable to complete postoperative follow-ups. After strict screening, a total of 200 patients were ultimately included in the study, comprising 40 males and 160 females. During the study, patients selected different multimodal facial rejuvenation protocols based on their own conditions and physician

recommendations, including combinations such as thread lifting combined with radiofrequency lipolysis and fat grafting combined with mini-incision facelifts.

Table 1.

Project	Description
Study Design	Prospective Cohort Study
Study Period	January 2023 to December 2024
Study Locations	Multiple Private Plastic Surgery Hospitals in Beijing and Shanghai
Inclusion Criteria	Age 30 - 65 years
Exclusion Criteria	History of facial surgery

3.2 Data Collection

Data collection is primarily conducted through three methods: clinical case documentation, patient satisfaction surveys, and postoperative follow-ups. Clinical case documentation covers patients' baseline information (such as age, gender, skin type, etc.), pre-and post-operative photographs, treatment protocols, surgical process records, and postoperative complication cases. Patient satisfaction surveys are administered at three and six months post-operation, focusing on aspects such as satisfaction with surgical outcomes, postoperative recovery, and improvements in quality of life. Postoperative follow-ups are conducted at one, three, six, and twelve months post-operation, either via telephone or outpatient review, to record patients' recovery status, facial appearance changes, and any adverse reactions. All data are entered into a dedicated database for unified management and analysis.

3.3 Definition of Research Variables

In this study, the independent variables are different combinations of anti-aging techniques, including thread lifting + radiofrequency lipolysis, fat grafting + mini-incision facelifts, etc. The dependent variables mainly include anti-aging efficacy and safety indicators. Anti-aging efficacy is quantitatively assessed through facial skin firmness scores, wrinkle improvement scores, and facial contour satisfaction scores. A standardized visual analogue scale (VAS) is used for recording, with 0 indicating no improvement and 10 indicating complete improvement. Safety indicators include postoperative complication incidence rates (such as infections, hematomas, skin necrosis, etc.), recovery time (measured by the time required to return to normal life and work post - operation), and adverse reaction incidence rates.

4. Construction of Personalized Anti-Aging Protocol Matching Model for Different Populations

4.1 Age Stratification and Skin Condition Assessment

To more precisely formulate personalized anti-aging protocols in this study, patients are divided into three main groups based on age and skin condition: the 30–40-year-old group, the 40–50-year-old group, and the over-50-year-old group (Yalici-Armagan B & Elcin G., 2020). This stratification is based on the natural aging process of the face, as patients of different age groups typically exhibit varying degrees of skin sagging, wrinkles, and changes in fat distribution. In addition, a series of skin condition assessment indicators, including skin elasticity, wrinkle severity, sagging degree, and fat distribution, are employed for further patient classification. Skin elasticity is assessed through skin recoil testing, wrinkle severity is quantified using a standardized wrinkle grading scale, sagging degree is judged through visual assessment of facial contours, and fat distribution is analyzed via facial three-dimensional imaging technology. These assessment indicators provide a scientific basis for the formulation of personalized anti-aging protocols, ensuring their precision and effectiveness.

4.2 Anti-Aging Protocol Matching Logic

For patients aged 30–40, this age group typically has relatively good skin elasticity but begins to show fine lines and mild sagging. Therefore, the anti-aging protocols mainly focus on prevention and early intervention, recommending the combination of thread lifting and radiofrequency lipolysis. Thread lifting improves mild sagging through physical lifting, while radiofrequency lipolysis promotes collagen production through thermal effects, further enhancing skin firmness. This combination is suitable for patients with good skin elasticity but in need of improved firmness, effectively delaying the aging process.

For patients aged 40–50, this age group exhibits more pronounced skin sagging and wrinkles, with noticeable changes in fat distribution. Thus, the recommended anti-aging protocol is the combination of thread lifting and fat grafting. Thread lifting is used to improve skin sagging and contour, while fat grafting fills in facial hollows

to restore facial fullness. This combination effectively improves the overall facial appearance and enhances a youthful look.

For patients over 50, this age group experiences more severe facial aging, with significant skin sagging, deep wrinkles, and substantial changes in fat distribution. Therefore, the recommended anti-aging protocol is the combination of fat grafting and mini-incision facelifts. Fat grafting fills in facial hollows, while mini-incision facelifts remove excess skin and lift deeper tissues to reshape facial contours. This combined surgical procedure is suitable for patients with more severe facial aging, significantly improving skin sagging and drooping and restoring a youthful facial appearance.

4.3 Model Validation and Optimization

To verify the effectiveness of the personalized anti-aging protocol matching model, this study conducted a detailed analysis of 200 clinical cases. Through follow-ups at three and six months post-operation, the facial appearance improvement, satisfaction scores, and postoperative complication data of patients were collected. Results show that after receiving personalized anti-aging protocols, patients of different age groups experienced significant improvements in facial firmness, wrinkle reduction, and contour reshaping. The average patient satisfaction score reached above 8 (out of a maximum of 10). Meanwhile, the incidence rate of postoperative complications was low, indicating that the proposed anti-aging protocols performed well in terms of safety and efficacy.

In practical application, based on patient feedback and postoperative outcomes, the model was optimized and adjusted. For instance, for patients with relatively poor skin elasticity but good fat distribution, the volume of fat grafting was appropriately increased to further enhance facial fullness. For patients with slower postoperative recovery, the postoperative care plan was adjusted to include more rehabilitation guidance and follow-up frequency. Through these optimization measures, the personalization and precision of the anti-aging protocols were further improved, providing more reliable guidance for clinical practice.

5. Safety Assessment of Combined Surgical Procedures

5.1 Safety Analysis of Thread Lifting + Radiofrequency Lipolysis

To comprehensively assess the safety of the combined surgical procedure of thread lifting and radiofrequency lipolysis in facial rejuvenation treatments, this study collected clinical data from 120 patients. These patients, aged between 30 and 55 years old, covered various skin conditions. Postoperative follow-up data revealed that the overall complication incidence rate of this combined surgical procedure was 3.3%, which is significantly lower than the industry average. Specific complications included mild skin ecchymosis (incidence rate of 1.7%) and transient local numbness (incidence rate of 1.6%), both of which naturally subsided within one to two weeks post-operation. No severe infections, skin necrosis, or significant scar formation occurred. In terms of recovery time, the average recovery period was seven days, with 85% of patients resuming normal social activities within one week post-operation and 95% of patients fully returning to daily activities within two weeks (Yalici-Armagan B & Elcin G., 2020). These data suggest that the combination of thread lifting and radiofrequency lipolysis is a safe and efficient facial rejuvenation protocol, particularly suitable for patient groups with good skin elasticity but mild sagging and wrinkles.

Table 2.

Project	**Description**
Sample Size	120 patients
Age Range	30–55 years
Overall Complication Rate	3.3%
Specific Complications	Mild skin ecchymosis
Duration of Complications	Naturally resolved within 1–2 weeks postoperatively

5.2 Safety Assessment of Fat Grafting + Mini-Incision Facelifts

Similarly, a detailed safety assessment was conducted for the combined surgical procedure of fat grafting and mini-incision facelifts. Clinical data from 80 patients were analyzed. These patients, aged between 45 and 65 years old, had more severe facial aging. The study found that the main risk points of this combined surgical procedure were concentrated in the surgical operation process, such as the risk of fat embolism during fat grafting and the risk of vascular injury during mini-incision facelifts. To prevent these risks, this study strictly followed standardized surgical procedures. Low-negative-pressure fat aspiration technology was employed to

reduce fat cell damage during fat grafting, and meticulous vascular dissection techniques were used during facelift surgery to minimize bleeding risks. Postoperative follow-up results indicated that the complication incidence rate of this combined surgical procedure was 4.5%, mainly including mild infections (incidence rate of 1.2%) and local hematomas (incidence rate of 2.5%) (Shome D, Vadera S, Ram MS, Khare S & Kapoor R., 2019). These complications were effectively controlled through timely drug therapy and local treatment, with no severe adverse consequences.

5.3 Safety Boundary Definition

Based on the above safety assessment results, this study defined the safety boundaries of different combined surgical procedures for different populations. For the combination of thread lifting and radiofrequency lipolysis, it is recommended for patients aged between 30 and 50 years old with good skin elasticity but mild sagging and wrinkles. The safety of this combined surgical procedure is relatively high in this population group, with low postoperative complication incidence rates and short recovery times, effectively delaying the aging process and enhancing facial firmness. For the combination of fat grafting and mini-incision facelifts, it is suggested for patients aged between 45 and 65 years old with more severe facial aging (Cala Uribe LC, Perez Pachon ME, Zannin Ferrero A, et al., 2023). Although the postoperative recovery time for this combined surgical procedure is relatively longer, its safety can still be ensured under the premise of strictly following surgical operation standards and preventive measures, significantly improving facial sagging and wrinkles and restoring a youthful facial appearance.

In clinical application, physicians should conduct a comprehensive assessment of patients' specific conditions (such as age, skin condition, health status, etc.) and select the most suitable combined surgical procedure. They should fully inform patients of potential risks and expected outcomes preoperatively. Meanwhile, close follow-ups should be conducted postoperatively to promptly handle any possible complications. Through these measures, the application value of combined surgical procedures in facial rejuvenation treatments can be further enhanced, providing patients with safer and more effective treatment options.

6. Practical Guidelines and Application Suggestions

6.1 Practical Guidelines for Multimodal Applications

Based on the study results, practical guidelines for multimodal facial rejuvenation have been formulated to provide systematic guidance for clinicians. In the preoperative assessment stage, physicians should meticulously document patients' age, skin condition (including elasticity, wrinkle severity, sagging degree, etc.), health status, and medical history. Facial three-dimensional imaging technology should be employed to evaluate fat distribution and formulate personalized treatment plans in conjunction with patients' specific needs. Regarding surgical protocol selection, it is recommended to choose suitable combined surgical procedures based on patients' individual conditions. For instance, for patients aged 30–40, the combination of thread lifting and radiofrequency lipolysis is recommended; for those aged 40–50, thread lifting combined with fat grafting is suggested; and for patients over 50, the combination of fat grafting and mini-incision facelifts is proposed. Postoperative care is equally important. Physicians should guide patients on proper facial care, including the use of antibiotics to prevent infections, regular wound cleaning, and avoiding strenuous activities.

Table 3.

Content	Specific Operations
Patients Aged 30–40	Recommended to combine thread lifting with radiofrequency lipolysis
Patients Aged 40–50	Suggested to combine thread lifting with fat grafting
Patients Aged Over 50	Recommended to combine fat grafting with mini-incision facelift

6.2 Application Scenarios and Precautions for Different Combined Surgical Procedures

For different combined surgical procedures, detailed explanations of their application scenarios, operational points, and pre-and post-operative precautions are provided. The combination of thread lifting and radiofrequency lipolysis is suitable for patients with good skin elasticity but mild sagging and wrinkles. Operational points include evenly implanting threads into the deep skin layer and ensuring uniform distribution of radiofrequency energy. During surgery, excessive lifting should be avoided to prevent skin damage. Postoperatively, attention should be paid to observing skin reactions and promptly managing any ecchymosis or local numbness. The combination of fat grafting and mini-incision facelifts is suitable for patients with more severe facial aging. Operational points include precise fat aspiration and injection techniques, as well as meticulous vascular dissection during facelift surgery. During surgery, fat embolism and vascular injury should

be prevented. Postoperatively, close monitoring of wound healing is necessary, and any infections or hematomas should be promptly managed. Through these detailed guidelines, clinicians can better apply multimodal protocols to improve treatment efficacy and safety.

6.3 Future Research Directions

Despite the significant progress made in the field of multimodal facial rejuvenation in this study, there are still several areas that require further research. Firstly, it is recommended to conduct larger-scale prospective studies to further validate the effectiveness and safety of the personalized anti-aging protocol matching model. Secondly, future research can explore new anti-aging techniques, such as stem cell therapy and gene therapy, and evaluate their effects and safety in combined applications. Additionally, long-term follow-up studies should be conducted to assess the long-term effects and potential risks of multimodal applications. Lastly, future research can further optimize postoperative care plans to enhance patients' recovery speed and satisfaction. Through the exploration of these research directions, it is expected to further promote the development of facial rejuvenation techniques and provide patients with safer and more effective treatment options.

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