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Exploring the Mechanism of Extracorporeal Shockwave Therapy for Facial Overfilling Syndrome

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Abstract

Objective: To explore the mechanism of extracorporeal shockwave therapy in the treatment of facial overfilling syndrome. **Methods:** Two cases of facial overfilling syndrome were selected as the research objects to compare their treatment effects and occurrence of adverse reactions. **Results:** After appropriate treatment, significant improvement in skin laxity was observed in two patients, manifested by a decreasing trend in the skin laxity score scale, with an average reduction of 1.75 levels. Simultaneously, during Duchenne's smiles, there was a noticeable elevation in the position of their oral commissures. These improvements not only enhanced the facial aesthetics of the patients but also boosted their confidence and comfort. **Conclusion:** Extracorporeal shockwave therapy has significant advantages and broad prospects in the treatment of facial overfilling syndrome. It can effectively alleviate pain, promote tissue recovery and reshaping, and demonstrate long-term therapeutic effects, thus improving patients' quality of life.

Keywords

Extracorporeal shockwave; Facial overfilling syndrome; Mechanism exploration

Facial overfilling syndrome, also known as Pillow Face, is a facial aesthetic problem caused by excessive or improper use of soft tissue fillers (especially hyaluronic acid). This syndrome is mainly manifested as facial contour imbalance and changes in functional anatomical structures, usually due to incorrect perception of facial aging and inappropriate evaluation, selection, and technical application of fillers. The use of facial fillers is on the rise globally, leading to a corresponding increase in the incidence of facial overfilling syndrome. This trend is influenced by the societal pressure for youthful and tight facial features. The clinical manifestations of facial overfilling syndrome are diverse, including abnormal facial contours, stiff expressions, lumps formed by filler migration, and foreign body sensations. These symptoms may cause the patient's face to appear unnatural and may even lead to functional impairments. Diagnosis of facial overfilling syndrome is usually based on clinical presentation and the patient's injection history. Current treatment methods include filler dissolution, surgical excision, and physical therapy. Extracorporeal shockwave therapy, as a non-invasive physical therapy, has the advantages of high safety and significant efficacy. Its mechanisms of action include promoting tissue regeneration, reducing inflammation, and accelerating metabolism. Extracorporeal shockwave therapy can precisely target lesion tissue by adjusting energy and shock frequency, thereby improving facial contours, and reducing lumps. Studying the application of extracorporeal shockwave therapy in facial overfilling syndrome aims to explore a safer, more effective treatment approach. This not only offers new treatment options for patients but also presents new directions for the development of the field of facial aesthetic medicine. Moreover, studying the mechanism of extracorporeal shockwave therapy helps deepen the understanding

of its role in facial soft tissue repair and regeneration, providing theoretical support for future medical research and treatment innovation.

In the treatment of facial overfilling syndrome, the application methods and steps of shockwave technology can refer to the following information: Understand the fundamentals of shockwave technology: Shockwave technology was originally used in high-speed gas dynamics to support supersonic flight and re-entry of space vehicles. Over the past three decades, this technique has been successfully applied to medical treatments, including the non-invasive removal of kidney and urethral stones [1].

Choosing the right shockwave device: According to existing research, shockwave therapy devices should have the ability to produce microexplosions and laser-induced jets of microwater, which is particularly important for the treatment of facial overfilling syndrome [1].

Pre-treatment and patient preparation: Before proceeding with shockwave therapy, a thorough evaluation of the patient, including a detailed examination of the face and possibly a CT scan, is required to ensure the safety and efficacy of the treatment. This step is similar to a 3D CT scan before the use of PEEK implants in facial reconstruction [2].

1. Material and methods

1.1 Materials

Case 1: A female, 45 years old, underwent multiple facial fat-filling surgeries at different clinics to improve facial depression and wrinkles. Currently, the face is excessively full, with the original facial contours disappeared and facial expression numbness.

Case 2: A female, 38 years old, received multiple treatments of facial hyaluronic acid filling at different beauty salons to increase facial stereopsis and youthfulness. Currently, the face is excessively swollen, with the forehead protruding excessively, the nose broad, obvious bulging of the lower eyelids, thick lips, sharp chin, and loss of facial features and coordination.

1.2 Methods

Using the Hunan Lifotronic extracorporeal shockwave therapy instrument, a 15mm diameter treatment head is used, and the pressure is set between 1.4bar and 2.0bar. The frequency is adjusted to 7-10Hz, focusing on fixed-point operation. Move from inside to outside, from bottom to top along the diaphragm direction. Direction from the corner of the mouth to below the cheekbone, mainly targeting the masseter muscle for treatment. Patients are instructed to smile during treatment, and when smiling, the position of the masseter muscle will change. Simultaneously, dynamic observation of changes is made during treatment, with reinforcement in local areas: such as the lower edge of the zygomaticus major muscle, nasolabial groove, and lower edge of the zygomatic arch, common injection sites. The total number of shots is between 3,000 and 3,500.

Then, a 20mm diameter treatment head can be used, and the pressure is set between 1.8bar and 2.5bar. The frequency is adjusted to 12-15Hz, and sliding operation is performed along the direction of the muscles, moving from inside to outside, and from bottom to top to modify the face shape. The total number of shots is between 1,000 and 1,500.

Treatment is performed once every 15 days, 2 times/month, 3 times/course of treatment. Both patients were treated 6 times in total, and after 6 treatments, a follow-up visit was conducted for reevaluation.

1.3 Evaluation index

Record the process, effects, and adverse reactions of extracorporeal shockwave therapy for the two patients and use objective and subjective evaluation indicators to evaluate the treatment effects.

1.3.1 Objective evaluation index

Before and after treatment, at rest and during maximum Duchenne-type smiling, measure the distance from the corner of the mouth to the mandibular line and nasion: At the mandibular line, mark a vertical line from the oral commissure line to the mandibular line at rest (not smiling), and measure the vertical distance from the oral commissure position to the mandibular line; this measurement value is considered the vertical position of the oral commissure. Draw a horizontal line connecting the nasion skin prominence and connect it with the vertical line passing through the oral commissure; this measurement value is considered the horizontal position of the oral commissure. Compare the

changes in measurement values before and after treatment.

1.3.2 Subjective evaluation index

Improvement of skin laxity: Referencing the clinically validated Skin Laxity Grading Scale (SLGS), doctors independently evaluate and record the clinical efficacy of patients before and after treatment. Specific evaluation criteria: Grade 0: No laxity; Grade 1: Mild laxity (limited to nasolabial fold laxity); Grade 1.5: Mild laxity (limited to nasolabial fold and early lip corner fold laxity); Grade 2: Moderate laxity (limited to nasolabial fold/lip corner fold laxity, early double chin, early submental laxity); Grade 2.5: Moderate laxity (obvious laxity of nasolabial fold/lip corner fold, with laxity of double chin and submental area); Grade 3: Severe laxity (nasolabial fold/lip corner fold significantly lax, with laxity of double chin and submental area, early neck band-like laxity); Grade 3.5: Severe laxity (nasolabial fold/lip corner fold deep lax, with obvious laxity of double chin and submental area, obvious neck band-like laxity); Grade 4: Extremely severe laxity (nasolabial fold/lip corner fold significantly lax, with significant laxity of double chin and submental area, neck with redundant tissue and obvious band-like laxity).

2. Results

The Skin Laxity Grading Scale, ranging from 0 to 4 (from best to worst), evaluated before treatment (by three independent and blinded assessors based on online 2D images during Duchenne-type smiling) averaged 2.25, and after extracorporeal shockwave therapy, it averaged 1.75.

During Duchenne-type smiling, the position of the oral commissure before treatment (in vertical and horizontal coordinates) was 4.21 cm and 4.02 cm respectively, while after treatment, the positions were 4.95 cm and 4.46 cm respectively. Both cases showed a significant improvement.

3. Discussion

The manifestations of facial aging mainly include thinning of the skin, reduced elasticity, changes in fat compartment volume, muscle atrophy, and bone absorption. These changes directly affect the contour of the face, causing it to gradually lose its original tightness and fullness. In particular, changes in facial subcutaneous fat and superficial fat compartments are direct factors causing changes in facial contour. Meanwhile, relaxation and reduced elasticity of facial supporting ligaments are important causes of facial soft tissue sagging. Muscle movement and aging also affect the strength of ligaments, causing the supporting ligaments to weaken and loosen, thereby leading to sagging and displacement of the supported soft tissues. Additionally, ligament relaxation and local fat accumulation contribute to the characteristic aging appearance of the face. On the other hand, facial overfilling syndrome is a complex facial issue involving various factors in its pathogenesis, including but not limited to anatomical structural abnormalities, muscle dysfunction, and changes in vascular and nerve distribution.

Extracorporeal shockwave therapy, as a non-invasive and highly effective treatment technology, has gradually gained widespread attention in the treatment of facial overfilling syndrome in recent years.

However, Shockwave (Extracorporeal Shockwave Therapy, ESWT) has its own unique advantages and disadvantages.

Advantage:

High safety: According to existing studies, shockwave therapy has shown a high safety profile and a low risk of side effects in clinical applications. For example, in one study on sound wave therapy, no serious adverse events were reported [3].

The results are significant: Shockwave therapy is effective in reducing the thickness of subcutaneous fat and improving the appearance of cellulite, resulting in body contouring and facial rejuvenation. In one study, patients treated with shockwave showed a significant reduction in the severity of cellulite and a reduction in hip circumference and circumference on the back of the thigh within 6 weeks of treatment [3].

Wide range of applications: Shockwave treatments are not only suitable for body contouring, but can also be used for facial rejuvenation, such as improving skin texture and reducing fine lines [4].

Inferior position:

Long treatment cycles: Although shockwave therapy is effective, it often takes multiple treatments to achieve optimal results. This can increase the financial burden and time cost for the patient.

Efficacy varies greatly from person to person: The effectiveness of shockwave therapy may vary from person to person due to individual differences. Some patients may need treatment for a longer period of time or with higher energy levels to see noticeable results [5].

Comparison with other techniques: Compared to other non-invasive facial contouring techniques, such as cryolipolysis and injectable lipolysis, shockwave therapy may not work as well as these techniques in some cases. For example, Cryolipolysis can act directly on fat cells, and results can often be seen more quickly [6].

This treatment method can precisely target damaged tissues, delivering high-energy shockwaves to achieve multiple effects such as pain relief, tissue recovery, and reshaping. Firstly, extracorporeal shockwave therapy can effectively alleviate pain. In facial overfilling syndrome, patients often experience discomfort and pain due to local tissue inflammation and compression. Shockwaves can penetrate deep into tissues, promoting local blood circulation through mechanical and cavitation effects, accelerating the metabolism and elimination of inflammatory substances, thereby significantly reducing pain. Secondly, extracorporeal shockwave therapy also plays a role in promoting tissue recovery and reshaping. In the treatment of facial overfilling syndrome, shockwaves can stimulate the regeneration of fibroblasts and collagen, enhancing tissue elasticity and resilience. It also improves local microcirculation, providing damaged tissues with sufficient nutrition and oxygen, promoting rapid tissue recovery and reshaping. Lastly, extracorporeal shockwave therapy demonstrates long-term therapeutic effects in the treatment of facial overfilling syndrome. Compared to traditional surgical treatments, shockwave therapy is non-invasive, minimally traumatic, fast-recovering, and does not leave scars. More importantly, it fundamentally improves tissue health and enhances tissue self-repair capabilities, thereby preventing disease recurrence.

The studies have found that excessive or improper use of soft tissue fillers (especially hyaluronic acid) can lead to facial contour disorders and functional anatomical changes, often associated with the masseter muscle [7, 8]. The masseter muscle originates from the zygomatic arch and merges into the orbicularis oris complex at the zygomatic bone. In addition, this study also observed a substantial fibrous connective tissue patch extending from the inferior aspect of the masseter muscle, attaching to the zygomatic and alveolar processes of the maxilla. At the anterior portion of this septum, the buccinator muscle is incorporated into the septum, which then merges with the orbicularis oris complex deep into the masseter muscle. This structure is named the "facial septum." The facial vein pierces through the middle of the masseter muscle's facial septum, with surrounding facial vein vessels blending with the facial septum. Furthermore, this study also observed varying numbers of facial nerve branches passing through the facial septum to reach the upper lip levator labii superioris muscle, buccinator muscle, and lower part of the orbicularis oculi muscle. This suggests that the facial septum plays an important role in the distribution of facial nerves and blood vessels. Based on observations, structural abnormalities or dysfunction of the facial septum after improper filling may be one of the important factors leading to facial overfilling syndrome. When the facial septum is abnormal, it may affect the normal distribution and function of facial nerves and blood vessels, leading to abnormal distribution and proliferation of facial muscles and adipose tissue [9-11]. Extracorporeal shockwave therapy is a non-invasive treatment that can improve the symptoms of facial overfilling syndrome by stimulating tissue regeneration, promoting blood circulation, and relieving pain. In this study, it was found that extracorporeal shockwave therapy can improve the distribution of facial nerves and blood vessels by adjusting the structure and function of the facial septum, thereby alleviating the symptoms of facial overfilling.

Anatomical observations show that the structure of the facial septum plays a key role in facial anatomy, being closely associated with structures such as the orbicularis oris complex and the masseter muscle, forming a complex network. The presence of the facial septum is important for maintaining facial morphology and promoting blood and lymphatic circulation. In terms of extracorporeal shockwave therapy, studies have found that high-intensity sound waves can induce shear stress, stimulate the self-metabolism of fat cells, accelerate the consumption and elimination of fat and improper fillers, thereby improving facial overfilling and adjusting the natural facial contour.

The use of shockwave therapy in plastic surgery is gradually expanding, especially in the management of facial overfilling syndrome. We can see that shockwave therapy as a non-invasive treatment has shown potential in the management of complications after plastic surgery. Shockwave therapy is used to treat asymmetry or excessive swelling of the face due to an overdose of injected fillers. This treatment helps reduce swelling and improve skin quality by using high-energy sound waves to promote the repair of damaged tissues and blood circulation. In addition, shockwave therapy has also been studied to reduce long-term side effects such as induration or bumpiness after filling injections. These side effects may affect the patient's appearance and self-confidence, and shockwave therapy offers a relatively safe and effective solution. Although current research has focused on the theoretical and preliminary clinical trial phases, the available data suggest that shockwave therapy has some efficacy and safety in the treatment of facial overfill syndrome. More large-scale clinical studies are needed in the future to further validate these preliminary results and explore their efficacy in different types of fillers and in different patient populations [12].

This study provides the first detailed description of the anatomical structure and functional characteristics of the facial septum, offering a new perspective for a deeper understanding of the pathogenesis of facial overfilling

syndrome. Additionally, this study preliminarily explores the potential application mechanisms of extracorporeal shockwave therapy in such syndromes, providing new ideas and methods for clinical treatment. However, this study still has certain limitations, and further clinical and experimental research is needed in the future to verify the actual effectiveness and safety of extracorporeal shockwave therapy in facial overfilling syndrome.

4. Conclusion

In summary, the application of extracorporeal shockwave therapy in facial overfilling syndrome effectively alleviates pain, promotes tissue recovery and reshaping, and exhibits long-term therapeutic effects.

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