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Application of Intratissue Laser Ablation in Facial Morphological Modification

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Abstract

Objective: To conduct a retrospective analysis of the therapeutic effects of laser ablation in maxillofacial applications.
Methods: Laser ablation was performed in 97 patients, 27 cases of facial fat accumulation, 40 cases of sagging caused by facial aging, 16 cases of soft tissue asymmetry, and 14 cases of facial hyperplasia. Laser parameters were as follows: lipolysis 8 W, 90–120 J/cm^2, and the ablation of hyperplastic tissue 9–10 W, 150–200 J/cm^2. The subcutaneous thickness, facial morphology, patient's self-evaluation, and satisfaction were evaluated.
Results: Laser ablation reduced the subcutaneous thickness, and tightened loose skin. The patient's appearance looked younger and more beautiful. The curves of the facial contours were more of Oriental beauty. The hyperplasia site became thinner, and the facial asymmetry was corrected or significantly improved. Most of the patients were satisfied with the outcome. There were no serious complications besides swelling.
Conclusions: Laser ablation can effectively treat thickening and relaxation of maxillofacial soft tissues. With low risk, few complications, and quick recovery, it can be used as a first-line treatment for maxillofacial soft tissue plastic surgery.

Keywords: laser, ablation, lipolysis, hypertrophy, maxillofacial surgery

Introduction

Facial deformity caused by local fat accumulation, hyperplasia, and hypertrophy is common in clinical practice, but it is difficult to achieve the desired clinical outcome by relying on traditional surgical treatment. First, it is easy to leave incision scars. Second, the subcutaneous fat of the maxillofacial area is thin, and the facial nerve is densely distributed in the deep layers. To avoid damage to the nerve, many tissues cannot be removed during surgical resection. Third, it is difficult to accurately remove excess tissue. At present, some noninvasive treatments are used for facial cosmetic plastic surgery, such as laser, radiofrequency, cryolipolysis, and ultrasound lipolysis.[1–10] However, these nontraumatic treatments are weak and it is difficult to achieve the desired effect of removing excess tissue under the skin.

For the past 10 years, we have been using 980 nm diode laser for subcutaneous tissue ablation for local maxillofacial tissue hyperplasia, fat accumulation, facial laxity, sagging, and so on. Excess tissue can be accurately removed. Due to being minimally invasive, postoperative recovery is fast, no incision scar is formed, and good clinical results have been achieved. We conducted a retrospective analysis as follows.

Methods

From June 2014 to June 2022, 97 patients received intratissue laser ablation, ages 13–54 years, 39 males and 58 females. There were 27 cases of facial fat accumulation, 40 cases of sagging caused by facial aging, 16 cases of soft tissue asymmetry, and 14 cases of facial hyperplasia.

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FIG. 1. Laser equipment: 980 nm diode laser, Velure S9, Modena, Italy. Fiber-guided needle.

The laser equipment used was 980 nm diode laser, Velure S9, Modena, Italy. The energy output mode was continuous, output energy 8–10 W, 80–200 J/cm^2. Fiber-guided needle and conventional surgical instruments were used (Fig. 1).

A tumescent anesthesia technique was used. The formula of the solution included lidocaine 100 mg, epinephrine 0.3 mg, and Ringer's solution 100 mL.

Marking the surgical area

Mark the site to be operated in an upright position before surgery, and mark the transition area at the junction of surgery and nonsurgery.

Tumescent anesthesia fluid was injected into the surgical area. A 3 mm incision was made in the nasolabial fold and a needle was inserted into the subcutaneous adipose tissue layer. The optical fiber was then inserted into the guide needle to reach the subcutaneous fat layer. With the nasolabial fold incision as a dot, it covered half of the lateral part radially, and the distance between the ends of the needle was 6–7 mm (Fig. 2).

The guide needle was punctured to the farthest end of the surgical area, the laser switch was turned on to release energy, and the guide needle was withdrawn while releasing energy. The movement speed of the optic fiber was 1 cm/15–18 sec. Avoid repeated release of laser energy close to the nasolabial fold incision to prevent excessive tissue destruction. During the treatment, the surface temperature of the skin is checked, and the temperature should not exceed 42°C. In the case of proficiency in operation techniques, the temperature change is sensed by placing your finger on the end of the fiber.

Transcutaneous illumination by the aiming beam ensured precise visualization of the region where the energy was delivered. The tip of the optic fiber was exposed 4 mm in front of the cannula, which could guide the laser directly into the adipose tissues without hindrance. When the light through the skin is too strong, it means that the fiber end is close to the epidermis. Treatment in this case can easily burn the skin. Therefore, it is necessary to adjust the distance between the optical fiber and the epidermis in time.

The laser energy was determined according to the thickness of the tissue and the characteristics of the tissue that needs to be ablated. Adipose tissue ablation requires low energy, usually 8 W, 90–120 J/cm^2 is sufficient. The ablation of hyperplastic tissue requires greater energy, usually 9–10 W, 150–200 J/cm^2.

The degree of tissue ablation was judged by observing the liquid spilled by the guide needle and the adhesion at the end of the fiber. When there is a visible yellowish liquid overflowing, it means that the energy is given too much, and it is necessary to adjust the movement speed of the optical fiber or reduce the energy output. When there is charred

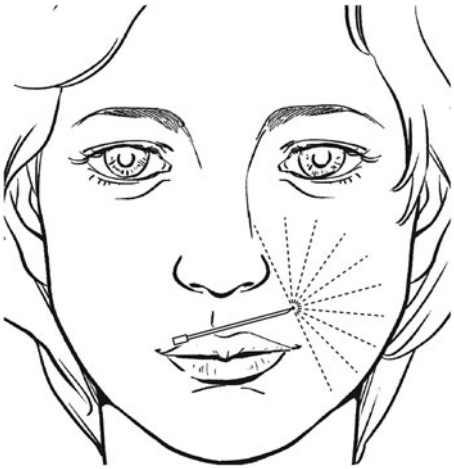

FIG. 2. A incision was made in the nasolabial fold and the guiding needle was inserted into the subcutaneous adipose tissue layer. The optical fiber was then inserted into the guide needle to reach the subcutaneous fat layer. With the nasolabial fold incision as a dot, it covered half of the lateral part radially, and the distance between the ends of the needle was 6–7 mm.

tissue adhering at the end of the fiber, it also means that the energy is too large. It is also necessary to reduce the energy output or speed up the fiber movement.

After surgery, the facial compression bandage was applied for 3 days, followed by a facial elastic sleeve for 1 month.

Evaluation items

Changes in the subcutaneous thickness. Ultrasound examination of the surgical site was performed before surgery and 6 months after surgery to measure the thickness of the subcutaneous tissue. Within 3 months after operation, the connective tissue hyperplasia and contracture caused by laser ablation had not been modified and rebuilt thoroughly. At this time, the thickness of the measured subcutaneous tissue is thinner than that of the modified subcutaneous tissue, which does not truly reflect the effect after surgery. Therefore, we chose to measure the thickness of the subcutaneous tissue at the surgical site 6 months after surgery.

Changes of facial morphology. Photographs were taken before and 6 months after surgery to observe changes in facial morphology, including facial symmetry and skin tightness. Plastic surgeons rated the facial morphology. There were 5 grades according to the degree of facial deformity: 1 poorer, 2 poor, 3 average, 4 good, and 5 better.

Patient's self-evaluation of efficacy. The degree of improvement in facial morphology was divided into five levels: 1 poorer, 2 poor, 3 average, 4 good, and 5 better.

Patient's satisfaction. Patient satisfaction with treatment effect was divided into three levels. One dissatisfied, 2 satisfied, and 3 very satisfied.

The obtained data were analyzed separately. Means and standard deviations were calculated. *t* Test was used to evaluate the differences in thickness between preoperation and postoperation. The Wilcoxon test was used to evaluate the differences in the scores of facial morphological changes, patient's self-evaluation, and satisfaction between preoperation and postoperation (IBM SPSS Statistics 19 version). p-Value <0.05 was considered significant.

FIG. 3. The patient at the top of the picture was a 38-year-old female with sagging facial skin, and intratissue laser ablation was performed. The facial skin became firmer after the procedure. The patient at the bottom of the picture was a 35-year-old female with accumulation of subcutaneous fat on the face. After laser lipolysis, the subcutaneous fat layer was thinned. From the perspective of Oriental beauty, the appearance also looked beautiful.

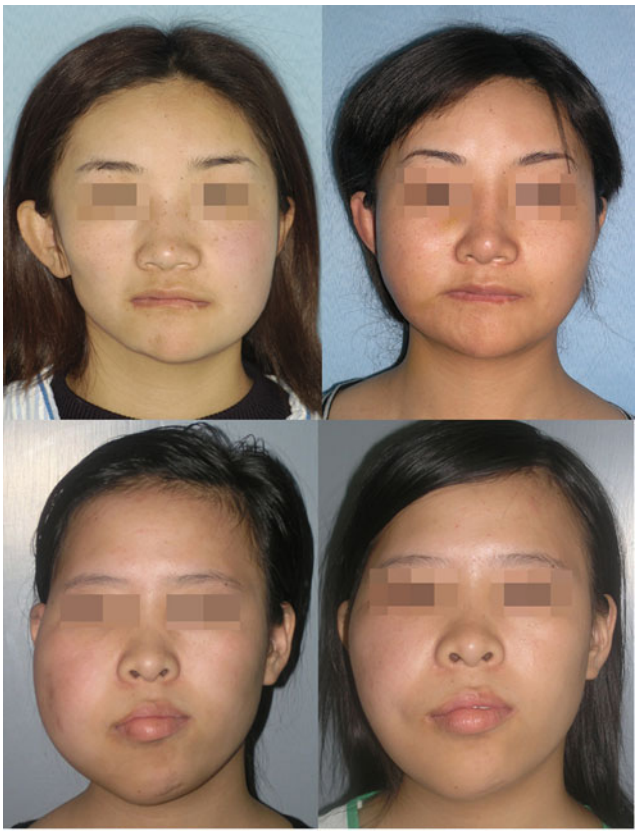

FIG. 4. The patient at the top of the picture was a 23-year-old female with facial asymmetry. Laser lipolysis was performed on the left side of the face, and the right side of the face was filled with autologous adipose tissue. The face looked roughly symmetrical. The patient at the bottom of the picture was a 14-year-old girl with hypertrophy on the right side of the face. After laser ablation treatment, the hyperplastic soft tissue was significantly thinned. Asymmetric deformities of the face were also significantly improved.

FIG. 5. The patient at the top of the picture was a 24-year-old female with hypertrophy of the masseter area. Intratissue laser ablation was performed. Hypertrophy disappeared in the masseter muscle area. The patient at the bottom of the picture was a 21-year-old female with facial fat accumulation. After laser lipolysis, the appearance looked beautiful.

FIG. 6. The patient at the top of the picture was a 26-year-old female with facial asymmetry, and the right side of the face was larger than the left. The right side of face had laser lipolysis. The face was symmetric after treatment. The patient at the bottom of the picture was a 29-year-old female with hypertrophy of the masseter area. Laser lipolysis was performed, and the thickness of masseter area became thinner.

Results

The change of subcutaneous thickness

The statistical results showed $p < 0.05$, and there were significant differences before and after surgery. The thermal effect generated by the laser resulted in melting and rupture of the subcutaneous fat and the subdermal collagenous. The thickness of the subcutaneous tissue became thinner after laser ablation in all of the groups.

Changes of facial morphology

The preoperative and postoperative photographs were compared and analyzed according to the aesthetic perspective of Oriental beauty. The comparison included the patient's facial contours, the degree of symmetry between the left and right, and the degree of sagging skin. The statistical results showed $p < 0.05$, and there were significant differences before and after surgery. The patient's appearance looked younger and more beautiful. The skin laxity became less or disappeared, and the skin looked elastic. The curves of the facial contours were more of

FIG. 7. The girl's face was deflective. After bone reconstruction, the right side of the face remained larger than the left in the area of mandibular margin. Intratissue laser ablation was performed. Both sides of the face became roughly symmetrical.

Table 1. The Results After Laser Ablation (Including the Change of Subcutaneous Thickness, Facial Morphology, Self-Evaluation, Satisfaction, and Complications)

Diagnosis	*Subcutaneous fat accumulation*	*Aging (skin laxity and sag)*	*Asymmetry of facial soft tissues*	*Facial hypertrophy*
N	27	40	16	14
Thickness				
Preoperation	7.47 ± 1.93	6.43 ± 1.50	8.63 ± 1.11	9.68 ± 1.40
Postoperation	5.17 ± 1.39	4.40 ± 0.85	5.75 ± 0.94	6.44 ± 1.06
p	<0.05	<0.05	<0.05	<0.05
Facial morphology				
Preoperation	2.74 ± 0.45	2.63 ± 0.49	1.81 ± 0.67	1.50 ± 0.52
Postoperation	4.70 ± 0.47	4.53 ± 0.51	4.25 ± 0.68	3.86 ± 0.66
p	<0.05	<0.05	<0.05	<0.05
Self-evaluation				
Preoperation	2.81 ± 0.56	2.48 ± 0.64	2.31 ± 0.49	2.00 ± 0.68
Postoperation	4.33 ± 0.55	4.20 ± 0.61	4.00 ± 0.52	3.86 ± 0.66
p	<0.05	<0.05	<0.05	<0.05
Satisfaction				
Dissatisfied	No	1 (2.5%)	1 (6.25%)	1 (7.1%)
Satisfied	15 (56%)	27 (67.5%)	11 (68.75%)	10 (71.4%)
Very satisfied	12 (44%)	12 (30%)	4 (25%)	3 (21.4%)
Complications				
Burn	No	No	No	No
Infection	No	No	No	No
Ecchymosis	No	No	No	No
Roughness	No	No	No	No
Scar	No	No	No	No
Swelling or edema	Yes	Yes	Yes	Yes

Laser ablation reduced the subcutaneous thickness and tightened loose skin. The patient's appearance looked younger and more beautiful. The curves of the facial contours were more of Oriental beauty. The hyperplasia site became thinner, and the facial asymmetry was corrected or significantly improved. Most of the patients were satisfied with the outcome. There were no serious complications besides swelling.

Oriental beauty. The hyperplasia site became thinner, and the facial asymmetry was corrected or significantly improved (Figs. 3–7).

Complications

There was swelling or edema within a week after the operation, and the symptom disappeared after a week. There was no burn, infection, ecchymoses, roughness, and scar.

Self-evaluation

Patients evaluated their postoperative results. The evaluation included changes in appearance, trauma and risks of surgery, and postoperative rehabilitation. Most patients felt that the appearance had changed significantly, the surgery was minimally invasive, and the postoperative recovery was fast.

Patient satisfaction

The patient evaluated the effect of the treatment. Patients with subcutaneous fat deposits on the face were all satisfied with the results. There were three patients who were not satisfied with the treatment effect, one case (2.5%) in the group of aging, one case (6.25%) in the group of facial asymmetry, and one case (7.1%) in the group of facial hypertrophy. For these three patients, although the surgery improved their appearance and morphology, it did not meet their expectations. The other patients in the three groups were satisfied or very satisfied with the outcome of the treatment (satisfied/very satisfied: 67.5%/30% in the group of aging, 68.75%/25% in the group of facial asymmetry, and 71.4%/21.4% in the group of facial hypertrophy).

The above results are shown in Table 1.

Discussion

Facial defects caused by abnormal soft tissue morphology are often encountered, including subcutaneous fat accumulation, sagging caused by facial aging, local soft tissue thickening, and asymmetry caused by hyperplasia. There are many treatments for these diseases, including surgical resection, liposuction, and noninvasive treatment such as laser, radiofrequency, ultrasound, and cryotherapy.[1–10] However, these treatments are flawed in the treatment of maxillofacial areas.

Subcutaneous fat accumulation on the face is usually treated with noninvasive methods such as liposuction, ultrasound lipolysis, and cryolipolysis. Due to the thin subcutaneous fat layer of the face and the dense distribution of facial nerves, liposuction does not remove much fat. In the short term after surgery, due to post-traumatic connective tissue hyperplasia and contracture, the subcutaneous tissue of the face will be thinned to a certain extent. After 3

months, the subcutaneous tissue of the face thickens again as the connective tissue degrades and the trauma site softens. Noninvasive methods such as ultrasound lipolysis, radiofrequency lipolysis, and cryolipolysis are less effective. Radiofrequency, laser, and ultrasound penetrate the skin and transmit to deep tissues with little energy, and the damage to deep tissues is weak. Whether it is subcutaneous fat accumulation or facial aging, these methods are difficult to achieve significant results. In addition, noninvasive lipolysis may cause hyperplasia of adipose tissue.[11,12]

Facial aging and local tissue hyperplasia and hypertrophy are usually treated surgically. Surgical incisions may leave incision scars and long recovery times after surgery. To avoid damage to the facial nerve, the amount of tissue resection in the local hyperplasia is often insufficient to achieve a better treatment effect.

We have been conducting intratissue laser ablation treatments in the clinic for 10 years.[13] We first applied this technology to the treatment of maxillofacial venous malformation, and gradually expanded to the ablation of subcutaneous fat, the ablation of local hyperplastic tissue, and the sagging caused by facial aging. Laser ablation effectively solves the difficult problems of maxillofacial treatment in the past, such as local tissue hyperplasia. The thermal effect generated by the intratissue laser resulted in the melting and rupture of the subcutaneous fat and the subdermal collagenous effectively.[14–16] The energy released by fibers piercing into tissues is much greater than that delivered by noninvasive means. The results are also far superior to those of noninvasive methods.

Unlike other parts of the body, the slightest morphological change in the face can cause a noticeable change in appearance, and even a change of 2 mm is enough to cause observable changes. These changes have an impact on the patient's social activity and psychology. Therefore, maxillofacial treatment requires precision and effectiveness. Second, the maxillofacial area has a dense distribution of nerves, and the subcutaneous fat layer is relatively thin, and it is easy to damage the nerves if you are not careful, which limits the amount of tissue resection during maxillofacial surgery and cannot meet the needs of the surgical purpose.

Laser ablation was used to treat fat accumulation, face aging, facial asymmetry, and facial hyperplasia by fat solving. Fat dissolving can achieve two effects. First, fat dissolving can thin the fat layer. Second, during the absorption of necrotic fat and tissue repair, new collagen connective tissue was formed. The collagen connective tissue contracted and tightened the skin.

Laser ablation treatment has the following advantages. (1) Minimally invasive, will not cause surgical scars. (2) It can accurately ablate the tissue that needs to be removed. (3) It can tighten loose skin. (4) Fast recovery after surgery. These advantages of laser ablation meet the needs of maxillofacial treatment.

Through retrospective analysis of previous treatments, laser ablation can effectively treat subcutaneous fat accumulation, facial sagging, local tissue thickening of the face, and facial hypertrophy with low treatment risk, high safety, and high patient satisfaction. In the patients we treated, there were no other serious complications other than transient postoperative swelling.

Conclusions

As a minimally invasive treatment, laser ablation can effectively treat thickening and relaxation of maxillofacial soft tissues. With low surgical risk, few complications, and quick recovery, it can be used as a first-line treatment for maxillofacial soft tissue plastic surgery.

Authors' Contributions

All the authors have contributed significantly, and they are all in agreement with the article. All patients signed an informed consent form before treatment, and agreed to the use of clinical data for academic communication and publication.

Author Disclosure Statement

No competing financial interests exist.

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