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REVIEW ARTICLE

Application of facial fat injections

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***Abstract*:** Autologous fat has become an ideal filler material due to its easy acquisition, good compatibility and no foreign body sensation after transplantation. In recent years, autologous fat has been widely used in facial rejuvenation or repair and reconstruction, and achieved satisfactory results, which is also in line with the currently advocated minimally invasive treatment direction. Autologous fat transplantation mainly includes fat extraction, separation, transplantation and postoperative treatment, each of which can affect the activity of fat particles and/or fat retention rate after transplantation. In this paper, the application of autologous fat in facial rejuvenation or reconstruction is described in detail.

Keywords: fat transplantation; facial rejuvenation; facial scar; facial hemiatrophy

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Autologous fat transplants date back more than a century. In 1893, German doctor Neuber filled small fat blocks of the upper arm into the depression of the cheek to repair the defect[1]. In 1950s, Peer proposed the theory of survival after fat transplantation[2]. In the 1980s, Klein invented swelling anesthesia and applied it to fat aspiration, enabling surgeons to obtain a large amount of granular adipose tissue under local anesthesia in the outpatient department, which laid a solid foundation for the rapid development of fat aspiration and fat transplantation[3]. The technology was once banned due to various reasons of fat necrosis, cyst or calcification, infection and other adverse reactions in the process of fat transplantation, but it has not been abandoned. With the unremitting efforts of some scholars, the concept and therapeutic effects of fat transplantation have been reevaluated and received more and more attention. Coleman put forward a new concept of fat transplantation in the 1990s through research, that is removing impurities from fat particles obtained by suction through centrifugation, transplanting it by using a 1 mL syringe, injecting a few amount to each point of each channel to ensure that fat particles obtain blood supply and can be survival. This technology is also known as structural fat transplantation or Coleman technology[4]. In 2010, Xie *et al.*[5] established the 3L3M transplantation method (low-negative pressure, low-dose, and low-speed centrifugation, multi-level, multi-channel and multi-point injection), which adhered to the principle of maximizing the retention of fat activity in each step of fat transplantation. In recent years, with the continuous improvement of basic research and clinical technologies, autologous fat transplantation has been widely applied in facial rejuvenation and facial contour remodeling, and satisfactory results have been achieved[6,7].

Compared with other filling materials, autologous fat has incomparable advantages, such as easy to be obtained, good histocompatibility, and no foreign body sensation after transplantation into the recipient area, so it is an ideal filling material. It can achieve the best therapeutic effect for patients with the minimum trauma, but also be in line with the current advocated minimally invasive treatment direction. Autologous fat transplantation mainly includes

acquisition, separation, transplantation and postoperative treatment, each of which can affect the activity of fat particles and/or the fat retention rate after transplantation. Each link of autologous fat transplantation and its application in facial rejuvenation or repair and reconstruction are described as follows.

The acquisition of autologous fat

Subcutaneous fat is distributed throughout the body and there are many suitable donor sites for fat transplantation. Although studies have shown that the amount of stem cells in adipose tissue of the lower abdomen and inner thigh is much higher than in other parts of the body[8]. However, most studies believe that there are no significant differences in cell activity and fat retention rate, vascularization, cyst formation and inflammatory infiltration after transplantation in different parts of the same individual, such as abdomen, lateral waist, medial thigh, lateral thigh, medial knee and breast[9,10]. In clinical application, fat transplantation retained rate is influenced by many factors, the current scholars tend to believe the various parts of the adipose tissue can provide large amounts of living cells, but get fat tissue at different positions of the difficulty, the corresponding loss may be different. Selecting which part to be the supplier area is mainly based on the convenience of access and the will of the patient.

Although lidocaine and epinephrine in swelling fluid have been reported to temporarily inhibit the activity of adipocytes, it is reversible and will not have a significant effect on the activity of adipocytes and the survival of transplanted fat particles[11–14]. It has also been reported that compared with the “dry extraction” method without swelling anesthesia, the activity of fat cells obtained after swelling anesthesia is significantly improved[15]. In the reports of clinical fat transplantation, swelling and anesthesia with the addition of lidocaine and epinephrine are mostly used. Generally, the fat is treated in the subsequent operation, and the residual drug concentration is very low, so the influence on fat survival can be ignored.

In the acquisition of adipose tissue, there is another important factor, namely suction negative pressure, currently used more syringe suction and liposuction machine suction. Syringe suction is flexible and easy to operate, but it is more laborious, while liposuction machine suction time saving, labor saving, can obtain a large amount of granular fat. Leong *et al*.[16] compared the suction effects of liposuction machine and syringe in terms of metabolic activity and lipogenic potential, and found no significant difference between them. It should be noted that the negative pressure should not be too large when using the liposuction machine, which is recommended to be less than 50 kPa. Studies have shown that when negative pressure is lower than 50 kPa, there is no significant difference in the damage of fat cells under different negative pressure; however, when the negative pressure is greater than 50 kPa, the damage degree of fat cells increases with the increase of negative pressure, especially when the negative pressure is greater than 95 kPa, the phenomenon of “fat boiling” will appear, that is, the vaporization of liquid will break fat cells and cause fat damage[16]. However, it is estimated that the maximum negative pressure generated by a 60 mL syringe can reach about –0.6 atm, which is equivalent to 61.22 kPa, and there is no quantitative difference with the negative pressure generated by the liposuction machine. In the case of low fat requirement, the relatively simple syringe suction method can be considered. In clinical practice, 10 mL threaded syringes can be used to connect suction straws with appropriate external diameter, and the low negative pressure produced by hand-controlled suction of 1–3 mL is sufficient for effective fat suction. It is usually more convenient and faster to obtain a large volume of granular fat by using a liposuction machine. Another advantage of machine suction is that a fat collection tank can be used to collect fat, which is convenient to filter out the fiber tissue in fat, so that fat particles are in uniform size, and are more conducive to fat injection and survival. At the same time, the method of adopting a fat collection tank can carry out the whole operation without contacting with the outside world, reducing the possibility of fat contamination. Fat particles for injection should not be too large, as small fat particles are more conducive to infiltration of tissue fluid in the area, conducive to survival. Therefore, the use of large diameter liposuction tubes should be avoided during fat suction. The recommended diameter of a liposuction tube is about 3 mm. Large fat particles can be obtained when the lateral pore size is 2–7 mm, while micro fat particles can be obtained when the lateral pore size is 1 mm.

Treatment of autologous fat

Fat particles obtained by aspiration also contain swelling fluid (about 30%), a small amount of blood, cell fragments, fibrous tissue and other impurities. Transplanting impurity-contained fat into the recipient area will increase the incidence of aseptic inflammation, and may have high absorption rate, infection, necrosis and low survival rate after surgery. Therefore, the fat transplanted to the recipient area should be treated appropriately to reduce the influence of various interfering factors on the postoperative effect. At the same time, reasonable treatment methods can

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increase the number of stem cells and the concentration of growth factors in adipose tissue, thus improving the fat retention rate.

Fat treatment methods mainly include rinsing, standing, centrifugation, and filtration. Rinsing, in which fat particles are repeatedly mixed with saline or lactate Ringer's solution, removes impurities such as blood, anesthetics, free lipid droplets, or cell debris. In the author's opinion, if there is a large injury during liposuction and fat containing a lot of blood and cell debris is extracted, rinsing should be performed to remove impurities, otherwise rinsing is not necessary. The three commonly used methods of fat purification, namely centrifugation, standing and cotton pad filtration, have their own advantages and disadvantages. They all aim at removing impurities such as water and oil. At present, the centrifugal method proposed by Coleman is relatively classic. After fat centrifugation, water, oil droplets and fat fragments can be removed to achieve "structural fat transplantation"[1]. However, some studies have found that the above different treatment methods have no significant impact on the survival rate of transplanted fat[9,17,18]. Roman *et al*.[19] transplanted fat obtained by centrifugation and cotton pad filtration into nude mice, and found no statistical difference in the survival rate of fat between the two groups, but the incidence of nodules in the cotton pad filtration group was significantly lower than that in the centrifugation group.

The author suggests that the centrifugal method should be used to fill the delicate parts of the face, which can improve the precision of injection volume and reduce the error of bilateral fat injection volume caused by different water content such as simple standing; it is particularly important in the face filling that needs to consider bilateral symmetry. Centrifugation also has the important advantage of being able to select high density fats of better quality. At present, scholars believe that gentle centrifugation has no significant effect on the activity of fat cells, and centrifugation can save the purification time and improve the density of viable fat particles. But the centrifugal force can not be too large in general, otherwise, the larger centrifugal force will destroy part of the fat cell. There are conflicting reports about how much centrifugal force to be used. Kurita *et al*.[20] recommended 1200 g and 3 min after comprehensive evaluation from the aspects of the activity of removing blood cells, preserving adipose cells and adipose stem cells, and the survival quality of the graft. Chinese scholars Yi *et al*.[21] found that after 1200 g centrifugation, the density of active cells and the content of stromal vascular fraction (SVF) were the highest in the fat particles in the bottom 1/3 layer, followed by the middle layer and the lowest in the upper 1/3 layer. Therefore, the retention rate of fat particles in the bottom 1/3 layer was about twice as high as that in the top 1/3 layer. Therefore, it is recommended to extract more granular fat and select the middle and lower adipose tissues for transplantation by centrifugation.

Autologous fat transplantation

Coleman[4,22] first proposed the concept that transplanted fat is tissue rather than a single cell in 1997. The fat initially transplanted to the donor site is provided with nutrients by infiltration of the surrounding host tissue fluid, and it generally takes 3–5 days for the surrounding tissue to grow blood vessels. Yoshimura *et al*.[23] have proved that when the diameter of transplanted fat particles is >3 mm, fat cells in the center of fat particles cannot survive or be replaced, resulting in ischemic necrosis, cyst and calcification, etc. Therefore, in order to ensure the survival of the transplanted fat particles, the multi-point, multi-tunnel and multi-layer injection method is needed to improve the contact area between the transplanted fat particles and the recipient area and obtain the maximum nutrition[5]. If the needle encounters great resistance in the process of moving forward, the needle should be removed and replaced. Violent operation should be avoided to prevent damaging the main blood vessels, nerves and other structures. The injection speed should not be too fast to accurately control the amount of single point injection, which is particularly important in the face fat transplantation. The greatest danger of facial fat injection is tissue necrosis, blindness, stroke, or death caused by embolism coming from the injection of fat into blood vessels. The key to prevent such serious complications is to precisely inject by using a 1 mL syringe with an 18 G blunt needle. In generally, single point injection can be controlled below 0.03 mL, and it can realize dynamic injection in the process of withdrawing the needle. It ensures that, in the event of mistakenly entering blood vessels, the amount of fat entering the blood vessels is minimal and does not cause fat emboli to flow backwards into the central retinal artery and internal carotid artery system.

Commonly used injection in the face can be subcutaneous, interfascial, intramuscular, periosteum injection and so on. Generally speaking, the deeper injection is usually aimed at increasing tissue capacity and protrusion, while the shallow injection can improve the surface roughness and play a good modification role. The level and direction of injection at different sites are different, so the anatomical structure of the injection site should be well known to the chest, and special attention should be paid to the distribution of important blood vessels and nerves. Due to the rich blood flow of muscle, fat

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transplantation into muscle should theoretically have a better survival, but at present, the anatomical sites that can be injected into muscle are relatively limited, and there is no clear conclusion on whether the muscle function with fine function is affected, and muscle activity may eventually affect the retention of fat volume.

Postoperative management of autologous fat injection

Studies have shown that there are almost no surviving fat cells at the site where hematoma forms during or after fat injection, indicating that the formation of hematoma has a great impact on fat survival. Therefore, some scholars suggest that pressure dressing should be given after fat transplantation to effectively prevent the occurrence of hematoma and the worsening of existing hematoma. However, the authors of this article believe that postoperative compression bandaging is not necessary. Blood vessels, especially arteries, generally have thick and elastic walls. If fat injection is not excessively rough, the probability of breaking blood vessels is small. If the needle encounters resistance in the process of moving forward, the surgeon needs to change the direction of the needle, rather than breaking through the resistance violently, otherwise it may damage the thick blood vessels. The key to prevent the formation of large hematoma is to carefully observe the subtle changes in the operative area during the operation, and press immediately if bleeding signs are found, rather than wait for the formation of large hematoma. Generally, fat injection can be continued after pressing for dozens of seconds to determine no bleeding, and a small amount of bleeding generally does not affect the survival of fat cells. Therefore, at the end of the operation, the hematoma that has been generated is impossible to resolve even through compression bandaging; the key is to prevent the formation of obvious hematoma. Patients should not massage the filling site within one month after surgery. To prevent the occurrence of infection, oral or intravenous antibiotics can be selected according to the time and scope of surgery. Antibiotics are commonly taken for 3 days. The swelling subsides 1 month after fat filling, and it takes 3–6 months for complete stability. After 6 months, whether to refill or nor can be decided according to the effect.

Applicable field of technology

At present, fat transplantation can be applied in a wide range of fields, mainly including two aspects. First, it is applied in beauty, mainly including facial rejuvenation, breast plastic surgery, and buttock shaping, among which facial rejuvenation is the most widely used beauty project[1,4–7,22,24]. Second, it is applied to the correction and repair of various congenital and acquired deformities, such as congenital hemifacial atrophy, secondary uneven depressions caused by various surgeries, like the depression caused by gluteal muscle contracture[25,26]. In addition, a large number of experimental and clinical studies have proved that fat transplantation can improve the symptoms and discomfort caused by various hypertrophic scars, and the exact mechanism is worthy of further study and observation.

Facial rejuvenation

Overview

Autologous fat filling for facial rejuvenation is one of the most common cosmetic surgeries. Middle-aged and elderly patients often have facial fat atrophy, which is manifested as uneven forehead, temporal depression, upper eyelid depression, buccal depression, flatness of zygomatic and nasal area, deepening of lacrimal groove, deepening of law lines and puppet lines. It is necessary to give appropriate granular fat injection to the above parts to restore facial fullness and achieve rejuvenation. In order to satisfy different aesthetic requirements, the principle of individuation should be paid attention to in the process of surgical design and implementation. Therefore, preoperative communication should be conducted with the patient to take the patient's requirements as the main reference factor, and appropriate suggestions should be given in combination with the patient's own situation. Photos of the patient when she was young with plump skin can be referred to. Through careful operation, the vast majority of patients usually can achieve good results after a fat transplantation, and the proportion of second filling accounts for less than twenty percent[24]. However, fat retention rate is influenced by many factors; fat transplantation at the same site may need to be performed many times in order to obtain good results, of which patients should be informed before surgery.

The distribution of facial fat is special. It is separated by various supporting ligaments and fibrous septa and exists in the state of "fat chamber". It is usually divided into superficial and deep parts by the superficial muscular aponeurotic system (SMAS) and facial expression muscles. It's found in all parts of the face. The deep fat chamber is generally located in the deep layer of the expression muscle and plays a supporting role to the superficial fat chamber. In order to effectively increase the volume of facial fat and achieve facial rejuvenation, multi-layer uniform

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injection combined with targeted injection of fat chamber is needed.

Frontal filling

The filling layer of the frontal part is subcutaneous tissue layer and muscle, and it is not recommended to inject into the lower layer of the cap aponeurosis, because this layer is loose, with more frontal muscle activity, and the fat being easy to shift.

Temporal filling

The temporal is bounded by the superficial temporal fascia. The subcutaneous tissue layer contains two fat chambers, namely the lateral temporal buccal fat chamber and the lateral orbital fat chamber, and two deep temporal fat chambers, namely the superior temporal ventricle and the inferior temporal ventricle, which are located in the loose honeycomb tissue between the superficial temporal fascia and the superficial deep temporal fascia. The 4 fat chambers in the temporal region are ideal recipient areas for fat transplantation, the medial border of the hairline and temporal line junction is a safe and effective injection site, and the first half of the inferior temporal ventricle is the “risk area” for injection[27].

Frontotemporal region filling

It is recommended that the frontotemporal region be extended to 1 cm inside the hairline and connected well to prevent step-like deformity at the hairline. In addition, botulinum toxin injection combined with frontotemporal region filling to reduce frontotemporal muscle and orbicularis oculi muscle activity can reduce the occurrence of frontotemporal region uneven.

Filling of the eyebrow arch

The filling level of the eyebrow arch is the upper periosteum and subcutaneous tissue layer, which can be filled under the whole length of the eyebrow arch. The visual effect of eyebrow lifting can be achieved after filling the temporal area and eyebrow arch.

Upper eyelid filling

The area to be filled is generally located in the 2/3 of the middle and inner of the upper eyelid, and the filling layers are mainly subcutaneous fat layer and the lower layer of orbicularis oculi muscle. In the early stage, orbital septal injection was advocated because of the concern that fat filling the superficial layer would cause mass, but now it seems that it is not necessary, and the most important thing is that the formation of obvious mass can be completely avoided after the injection of uniform small particle fat. It should be noted that the survival rate of upper eyelid fat is high, and excessive injection is not recommended[28].

Midface filling

The anterior part, especially the middle part of the face, is easier to age than the lateral part because of its special anatomical characteristics. There are also shallow fat chambers and deep fat chambers in the middle of the face. The four shallow fat chambers are temporal-buccal lateral, mid-buccal, medial buccal and nasolabial lateral fat chambers from the outside to the inside, and the deep fat chambers are medial deep fat chambers and lateral buccal fat pad, respectively[29]. The medial buccal deep fat chamber can be subdivided into the medial and lateral parts. The lateral part is located under the zygomatic major muscle, supporting the zygomatic major muscle and the superficial structure above. After filling the fat chamber, the middle face protrudes, which is one of the characteristics of youth[30].

Filling of other parts

To fill the lacrimal sulcus, nasolabial sulcus and chin, fat is injected evenly into the periosteum and subcutaneous tissue layers. The skin of lower eyelid is thin, and the injection of subcutaneous tissue layer is uneven and easy to form small induration. However, if this layer is not filled, the improvement effect of lacrimal groove is often not ideal. The nasolabial groove should be filled simultaneously with the alar base. The filling of the lateral buccal depression also follows the principle of multi-point and multi-level injection evenly, but at this depression there is often zygomatic arch ligament with dense structure connecting the periostium of the lower margin of the zygomatic arch and dermis, making multiple filling needed.

Nanofat/ECM/SVF-Gel sharp needle intra dermal fat injection technology

Recent studies have found that injection of fillers into the dermis can alleviate skin wrinkles, but conventional fat particles cannot be injected into the dermis due to their large diameter. Nanofat or extracelluar matrix (ECM)/SVF-Gel can be injected with sharp needle intradermal fat Injection, SNIF) technology. Tonnard *et al*.[30] obtained adipose tissue through mechanical emulsification and filtration in order to achieve shallow dermal injection with 27 G sharp needle, and the filtered tissue was collected and named nanofat. Nanofat obtained by this method does not contain active fat cells but is rich in fat stem cells. It was found that nanofat could significantly improve skin quality, such as dark circles under the eyes and perioral wrinkles, after subdermal injection with sharp needle combined with micrograngular fat transplantation. This effect has been confirmed in clinical work. The

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fat cells in nanofat are basically destroyed, so they generally do not increase the capacity. On this basis, Chinese scholars Lu *et al*.[32] further processed nanofat, separated and removed the liquid and fat droplets in nanofat through high-speed centrifugation and extraction, and obtained ECM and SVF-rich complex named ECM/SVF-Gel. In addition, a nude mouse model of wound healing was used to prove that ECM/SVF-Gel injection could significantly improve the wound healing speed, which was better than SVF alone. The role of ECM/SVF-Gel mainly depends on the stem cells contained in it or the ECM components. Generally, only 1–2 mL ECM/SVF-Gel can be prepared from 10 mL adipose tissue, which is characterized by retaining the ECM component in adipose tissue, and the ECM of adipose tissue has the ability to spontaneously induce lipid formation. Therefore, the volume retention rate after ECM/SVF-Gel transplantation reached 85%, higher than the volume retention rate after conventional adipose tissue transplantation[33,34]. According to the characteristics of granular fat, nanofat and ECM/SVF-Gel, they can be combined to achieve better results, such as filling granular fat in the deep lacrimal groove, filling ECM/SVF-Gel in the subcutaneous tissue layer, and combining nanofat if there are dark circles.

Fat transplantation to repair facial deformities and defects

In clinical application of fat transplantation for malformation and defect repair, congenital hemifacial atrophy, uneven skin surface after facial fat aspiration and depression after oral and maxillofacial malignant tumor radical resection are more common. The stem cells in adipose tissue not only play the role of filling and restoring the volume, but also effectively improve the skin texture and promote the vascularization due to their remarkable regenerative tissue ability, exerting their functions in regenerative medicine. Rigotti *et al*.[35] first reported in 2007, that applying fat granule to the treatment of ulcer after breast cancer radiotherapy, the composition of stem cells in fat tissue can effectively improve the damaged blood supply and fibrosis, reverse ischemia by district organization, make damaged tissue regeneration restored and eventually heal chronic ulcer, with satisfactory results. Clinically, after fat filling for patients with facial atrophy and defects, not only the volume of the affected side is significantly increased, but also the skin texture of the affected side is significantly improved, as pigmentation gradually lightens, approaching normal skin tone, and skin elasticity is significantly improved[25,36].

There are many reasons for postoperative unbalance, most of which are caused by poor operator technique, excessive or insufficient fat suction or inadequate level control. As face fat content is low, correction of such irregularities requires the extraction of fat from other parts of the body. If the dermis is fused to the deep fascia, the adhesive can be selectively released intraoperatively using a 16 G needle tip or other small sharp tools or even a blunt liposuction tube. It is important to avoid large strips of the adhesive forming a clear cavity. After the release, the fat particles are evenly filled into the many dispersed small gaps formed by the peel to prevent re-adhesion. In principle, layered cross-injection should be performed, but when subcutaneous tissue is rare, single-layer injection can be performed, as long as local depressions are filled. In some severe cases, multiple fat fillings are required. In addition, the local depression caused by facial tumor resection or trauma is generally deep, the skin and deep tissue adhesion is close, and the skin and periosteum are often directly adhesion, hard texture, especially after malignant tumor surgery combined with radiotherapy, local fibrosis and scar adhesion will be more prominent. In these cases, fat particles can be evenly tiled in the subcutaneous tissue layer of the depression area, which generally requires multiple injections. The purpose of the first fat injection is mainly to lay a layer of fat between subcutaneous tissue layer and deep tissue, separate the two layers of tissue, prevent adhesion recurrence, and can improve local skin texture. It is feasible to inject again after half a year, and clinical practice shows that the effect after filling is more satisfactory.

Fat grafting improves scar texture

A large number of studies have shown that fat transplantation can not only fill the depression caused by scar, but also stimulate collagen regeneration, thereby increasing dermal thickness, improving skin texture and relieving pain caused by scar[37,38]. Other studies have shown that the scarred dermis after fat transplantation has the same properties as the normal dermis[36,39]. The mechanism of fat transplantation alleviating pain caused by scar may be related to the improvement of local microenvironment by fat stem cells and secretion of some substances that prolong pain loss[40,41]. After comprehensive burns, obvious hypertrophic contracture scar will be formed, affecting facial expression and function. Autologous fat particles are injected into the subdermal layer of facial scar of these patients for many times, and postoperative follow-up shows that the texture, thickness and color of scar are significantly improved[42,43]. Histological examination revealed collagen deposition, angiogenesis, dermal growth and other manifestations of skin regeneration[42]. In the

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experimental study of rabbit ear hypertrophic scar model, the author found that injection of adipose stem cells or their conditioned culture medium into scar can inhibit the formation of hypertrophic scar, suggesting that adipose stem cells may regulate scar through its paracrine mechanism[44]. A review of the literature reveals many successful reports on the improvement of scar by fat transplantation, suggesting that this technique is safe and effective. However, there are few randomized controlled studies on fat transplantation or fat stem cells to improve scar, and relevant studies need to be further advanced.

Complications and management

The complications of fat transplantation can be classified as mild, moderate and severe. The mild complications mainly include edema, ecchymosis, skin redness, acne and headache. Moderate complications mainly include cyst, calcification, unevenness, bilateral asymmetry, and scar. Severe complications include skin necrosis, blindness, stroke and even death caused by vascular embolism. The occurrence of complications is closely related to the technique and experience of the surgeon, so the surgeon should have a complete understanding of these complications and reduce the occurrence of complications as much as possible. Mild complications generally do not need to be treated and most of them can be relieved by themselves, but patients should be informed before surgery. The main reason for the formation of cysts and calcifications is that the transplanted fat particles are not completely alive, which is common after the fat injection in the breast, while the face is generally less common due to better blood transport. The occurrence of this complication is mainly related to injection technology, fat quality and injection frequency. The more injections, the more likely cysts and calcifications are to form. Frozen fat is far more likely to form cysts after injection than fresh fat, so fresh fat is currently recommended as a priority. Once cyst nodule is formed, treatment is more difficult. Generally, for cysts with a diameter greater than 2 cm and containing liquefied fat, acupuncture can be used to extract the liquefied fat, and compression fixation can be given to promote its narrowing and closure. Small cysts or calcified nodules generally do not need to be treated. Follow-up observation is enough, but patients should be informed before surgery. Small nodules can also be removed by minimally invasive surgery if they are located at the superficial layer of subcutaneous tissue. When fat filling is excessive, fine-tuning of fiber fat dissolution can be performed half a year after injection to remove excess fat, but the operation of fiber fat dissolution is also closely related to the operator's experience and technology, and may require multiple treatments. For under-filled areas, it is recommended to wait at least 3 months before filling, and the authors generally recommend that patients wait at least 6 months before deciding whether to have a second injection. The most serious complication of fat injection is embolism, which can cause blindness, stroke and even death. During injection, some basic principles should be followed, such as using blunt injection needles, no violent operation, and injecting while withdrawing. The most important thing is that the amount of fat injected at each point should be less, controlled in 0.02–0.03 mL. In case of partial or total visual loss, strabismus, eyeball pain, nausea, vomiting, headache and other discomfort during local anesthesia surgery, the injection should be stopped in time, and emergency symptomatic treatment should be conducted by neurology department or ophthalmology department.

Conclusion

Although the technology of facial fat transplantation has been mature, the treatment of some complications is still difficult, the key is to prevent them. Therefore, before surgery, the operator needs to have a thorough understanding and proficiency in the technical essentials of fat transplantation and facial anatomy. The key technical points of fat transplantation in face are summarized as follows: reducing the damage to adipose tissue as much as possible during fat aspiration; in order to reduce the error and improve the quality of the injected fat, the basic principles of fat injection should be strictly followed, and the amount of fat injected at a single point should be controlled.

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