

MORPHOLOGICAL CHARACTERISTICS OF COMPLICATED COURSE OF LIPOFILLING

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Abstract. Morphological and immunohistochemical studies of complicated lipofilling outcomes revealed five main types of tissue reactions: lipogranuloma, cyst with fibrous capsule, fibroma, lipoma, and non-encapsulated fat necrosis. Each form had a different anatomical location, time of manifestation, and nature of the inflammatory-reparative response.

Keywords: lipofilling, morphology, complication

Relevance. Lipofilling is currently considered not only as a method of volumetric correction but also as a biologically active form of autologous transplantation capable of initiating tissue regeneration processes. This circumstance determines the growing interest of both practical medicine and fundamental science in studying the mechanisms of fat graft survival (1, 2, 3, 4, 5).

Lipofilling is a modern, minimally invasive method of contour plastic surgery that involves the transplantation of the patient's own fat tissue from donor areas to problem areas of the body. This procedure helps to correct body imperfections, smooth out hollows, and add volume to the breasts, buttocks, face, and hands. Lipofilling offers several advantages over other methods, including a low risk of rejection, long-lasting results, minimal trauma, and a short recovery period. However, certain complications are possible after such surgeries, and everyone who plans to undergo fat grafting should be aware of them (1, 2, 6, 7, 8). Factors that can lead to undesirable consequences after fat grafting can be divided into three broad groups: those related to the patient's individual characteristics, those caused by errors during the surgery itself, and those caused by improper care during the recovery period (1, 2, 9, 10, 11). The first group of causes includes individual factors such as a tendency to form keloid scars, blood clotting disorders, diabetes, chronic infections, and inflammatory diseases. These

factors complicate the tissue healing process, increase the risk of infection, and impede graft engraftment (1, 12, 13, 14, 15).

The second group of causes includes surgical errors, such as injury to nerve trunks and major vessels, excessive graft insertion, and uneven distribution of fat cells within the tissue. The risk of such complications directly depends on the qualifications and experience of the surgeon, so it is crucial to carefully select a clinic and specialist. Preference should be given to reputable medical institutions and plastic surgeons with extensive experience, using advanced equipment, and innovative lipofilling techniques. The third group of factors involves the patient's failure to follow recovery recommendations. This includes failure to wear compression garments as prescribed, early physical activity, visiting a steam room, sauna, solarium, or swimming pool, and neglecting postoperative incision hygiene. All of these errors slow the healing process, provoke inflammation and graft displacement, and lead to deformities of the body contours. Therefore, it is extremely important to strictly follow all of the surgeon's recommendations for caring for the donor and recipient sites for several weeks after lipofilling.

Donor Site Complications

The areas of the body from which fat tissue is harvested for subsequent transplantation are called donor sites. The most common donor sites are the inner thighs, knees, and lower abdomen—areas with sufficient fat reserves. During the surgery, I make small punctures in these areas through which I insert a thin cannula to aspirate the fat cells. Despite the minimally invasive nature of the procedure, certain problems may develop at the donor sites.

Early complications in the fat harvesting area include hematomas—bleeding caused by damaged blood vessels. They present as aching pain, a swollen sensation, and irregularly shaped bruises on the skin. Hematomas cause significant discomfort but pose no health risk and resolve spontaneously within 2-3 weeks.

The next most common complication is postoperative wound infection. This occurs due to failure to observe aseptic and antiseptic precautions during surgery, as well as improper suture care by the patient. Inflammation manifests as skin redness, swelling, localized fever, and purulent discharge from the wound. In such cases, it is necessary to immediately consult a doctor for antibiotic therapy and antiseptic dressings. Otherwise, the infection can spread to surrounding tissues and even cause sepsis—a generalized inflammatory response.

Unevenness and lumps of the skin at the liposuction sites often bother patients in the late post-lipofilling period. This occurs due to uneven aspiration of fat tissue and

incomplete skin contraction after removal of excess fat deposits. In most cases, these defects can be corrected with repeat lipofilling or liposuction.

Another problem experienced by approximately half of patients is numbness or increased sensitivity of the skin in the donor areas. This sensation is associated with the transection of nerve fibers during liposuction and usually disappears completely within 3-6 months.

A relatively rare but extremely unpleasant complication is the accumulation of lymphatic fluid, resulting in the formation of seromas. These seromas are small, dense-walled cavities filled with clear or yellowish fluid. Seromas often form due to excessive tissue trauma and impaired lymph flow.

Objective of the study. To analyze the morphological and immunohistochemical patterns in complicated lipofilling procedures.

Material and Methods. To assess the morphological structure of complicated lipofilling procedures, excised or biopsied adipose tissue fragments were analyzed from 34 patients with confirmed clinical aesthetic complications of lipofilling. The obtained samples were subjected to histological and immunohistochemical examination.

Results and discussion. The most common morphological complication across all anatomical locations was lipogranuloma, diagnosed in 11 patients (32.4%). The second most common complication was cysts with a fibrous capsule, detected in 10 patients (29.4%). The third most common complication was fibromas, consisting of dense fibrous connective tissue without signs of inflammation. They were detected in 6 patients (17.6%) and distributed relatively evenly across all surgical sites.

Finally, fat necrosis without capsule formation was observed in 4 patients (11.8%).

The morphological structure of aesthetic complications following lipofilling varies depending on the anatomical site, timing of manifestation, and predominant pathogenetic mechanisms (inflammation, fibrosis, fatty proliferation). The most aggressive morphological course (cysts, lipogranulomas, necrosis) is observed with lipofilling of the mammary glands, which is consistent with previously identified immunological predictors and the clinical picture.

Lipogranuloma was the most common form of complicated lipofilling outcome, diagnosed in 11 of 34 patients (32.4%). These lesions were predominantly detected during lipofilling of the mammary glands (n=6) and gluteal region (n=3), with isolated cases reported on the face (n=1) and other locations (n=1).

Clinically, lipogranulomas manifested as dense, sometimes painful areas, detectable 2 to 4 months after the procedure. Microscopically, lipogranuloma is characterized by a central zone of fat necrosis surrounded by a rim of macrophages, epithelioid, and

multinucleated foreign body giant cells, followed by the formation of a fibrous connective tissue capsule of varying thickness. Lipid deposits, cholesterol crystals, and signs of small vessel vasculitis are often observed in the intercellular space. Immunohistochemically, intense expression of CD68 (a macrophage marker) was detected in the lipogranuloma zones at the periphery of necrosis, particularly pronounced along the border with viable adipose tissue. Positive cells formed dense clusters (score 3, diffuse). IL-6 expression was detected in the cytoplasm of macrophages and isolated fibroblasts (score 2), predominantly in the area of active inflammation. TGF- β 1 was detected in fibroblasts and pericapillary structures of the capsule, indicating a fibrogenic inflammatory potential (score 2-3, focal).

Cysts with dense fibrous capsule formation were detected in 10 patients (29.4%) with complicated lipofilling outcomes. They were most frequently observed during breast lipofilling (n=7), less frequently in the gluteal region (n=2) and perineum (n=1). Unlike lipogranulomas, cystic lesions were characterized by a lesser inflammatory component and a predominance of tissue degeneration.

Clinically, cysts manifested later, typically 3.5-5 months after the procedure. Microscopically, cysts were represented by a cavity surrounded by a dense fibrous capsule, 100 to 300 μ m thick, without a distinct epithelial lining. Within the cavity, remnants of destroyed adipocytes, fragments of connective tissue, and cholesterol crystals were observed. Isolated macrophages and lymphocytes were present at the periphery, but no pronounced inflammatory infiltrate was observed. In some cases of long-standing cysts, areas of hyalinosis of the wall and calcification deposits were observed.

Immunohistochemically, single CD68⁺ macrophages were detected in the cyst wall, predominantly in areas adjacent to the cavity (score 1, focal). IL-6 expression was minimal or absent (score 0-1), emphasizing the absence of an active inflammatory response at the time of removal. Meanwhile, TGF- β 1 expression in capsular fibroblasts remained moderate (score 2, focal), possibly indicating ongoing fibrotic tissue remodeling.

Clinically, cysts with fibrous capsules are particularly significant in breast lipofilling, as they can simulate benign and even cancerous lesions.

Fibroma, as a morphological form of complicated lipofilling, was detected in 6 patients (17.6%). It was observed in the buttocks (n=2), mammary glands (n=2), face (n=1), and other areas (n=1). This type of complication typically developed late (4 to 6 months after surgery), unlike inflammatory or cystic complications, which manifest early.

Microscopically, fibroma is represented by mature fibrous connective tissue, with a predominance of parallel-oriented collagen fiber bundles, a moderate number of

fibroblasts, and sparse vascular structures. IHC analysis revealed the presence of fibroma, which demonstrated low to moderate expression of CD68+, predominantly as solitary macrophages in the interstitium (score 1). IL-6 expression was virtually undetectable (score 0-1), confirming the absence of active inflammation. At the same time, TGF- β 1 was consistently detected in the cytoplasm of fibroblasts and perivascular zones (score 2-3), reflecting the dominance of fibrogenic tissue remodeling.

With long-standing fibroma areas, partial hyalinous degeneration was observed, confirming a complete chronic process.

Lipoma as a morphological form of complicated lipofilling was detected in 3 patients (8.8%) and occurred in the face (n=1), breasts (n=1), and buttocks (n=1). This form had the least clinical significance in terms of inflammation, but caused significant aesthetic discomfort, especially in exposed and contoured areas.

Microscopically, lipoma is represented by a lobular mass of mature adipose tissue surrounded by a thin connective tissue capsule. Adipocytes are large, with distinct membranes, and there are no signs of necrosis or inflammation. Occasionally, isolated fibroblasts and capillaries were observed in the interlobular septa. Lipomas differed from normal subcutaneous adipose tissue by the presence of a capsule and the absence of volume regression over time.

Immunohistochemically, lipomas were characterized by negative or weakly positive CD68+ expression (score 0-1), confirming the absence of a macrophage inflammatory component.

IL-6 and TNF- α were not detected in lipoma tissue. TGF- β 1 was detected focally in isolated fibroblasts in the septa, but without diffuse activity (score 1, weak intensity).

Fat necrosis without connective tissue capsule formation was detected in 4 patients (11.8%) and occurred in one case per site: face, breasts, buttocks, and other sites. This form of aesthetic complication was characterized by the earliest stages of clinical manifestation and was associated with an acute local inflammatory process arising as a result of the massive death of fat cells.

Morphologically, this type of complication was characterized by fields of destroyed adipocytes, membrane loss, accumulation of fatty debris, cholesterol crystals, and a pronounced inflammatory infiltrate consisting of macrophages, neutrophils, and lymphocytes. A capsule was not formed, the lesion's contours were blurred, and the surrounding tissue was edematous, with signs of vasculitis.

IHC revealed maximum CD68+ expression (score 3) in the area of fat necrosis without a capsule, particularly in macrophages forming ring-shaped and focal clusters along the periphery of the necrotic lesion.

IL-6 was also detected in macrophages and individual fibroblasts (score 3); its expression was diffuse, indicating an active cytokine response.

TNF- α was detected in the vascular wall and mononuclear cells, confirming the involvement of innate immunity. TGF- β 1 was weakly expressed in these areas (score 1-2), localized primarily in the surrounding connective tissue, indicating an incomplete remodeling phase. For example, in patient K., 40, a large mass with signs of inflammation developed three weeks after 120 ml of lipofilling of the buttocks. The excised tissue turned out to be a necrotic lesion without a capsule, with intense expression of IL-6 and CD68+, and a virtually complete absence of TGF- β 1.

Thus, morphological and IHC studies of complicated lipofilling outcomes allowed us to identify five main types of tissue reactions: lipogranuloma, cyst with a fibrous capsule, fibroma, lipoma, and fat necrosis without a capsule. Each form had a different anatomical location, time of manifestation, and nature of the inflammatory and reparative response. The most pronounced inflammatory and fibrotic changes were observed in breast lipofilling, consistent with previously identified clinical and immunological risk predictors.

IHC expression of CD68+, IL-6, and TGF- β 1 varied depending on the type of complication: highest values were observed in fat necrosis and lipogranuloma, while lowest values were found in lipoma and fibroma. These data confirm the presence of a local pathological substrate for complicated outcomes, developing in the context of systemic immune imbalance.

Conclusions.

1. Unencapsulated fat necrosis is an acute inflammatory complication arising from unsuccessful graft vascularization and a pronounced innate immune response.
2. Morphological and immunohistochemical studies of complicated lipofilling outcomes identified five main types of tissue reactions: lipogranuloma, cyst with a fibrous capsule, fibroma, lipoma, and unencapsulated fat necrosis. Each form had a different anatomical location, time of manifestation, and nature of the inflammatory-reparative response. The most pronounced inflammatory and fibrotic changes were observed with lipofilling of the mammary glands, consistent with previously identified clinical and immunological risk predictors.

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