

## CLINICAL AND IMMUNOLOGICAL CHARACTERISTICS OF PATIENTS WITH VARIOUS OUTCOMES OF LIPOFILLING

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**Abstract.** The most pronounced immunological disturbances were observed with lipofilling of the mammary glands, which corresponds to the high clinical complication rate in this area. The data obtained confirm the presence of an immunological predisposition to an unfavorable outcome of the procedure and can serve as a basis for developing a risk prediction system.

**Keywords:** lipofilling, immunity, complications

**Relevance.** A review of literature on the issue of fat tissue engraftment after lipofilling revealed that investigating the causes and mechanisms of complicated outcomes in this procedure requires a comprehensive analysis of not only clinical data but also the immunological and morphological context within which the adverse outcome of the procedure occurs (1,3,5). Furthermore, given that lipofilling surgery involves the transfer and integration of autologous tissue, the outcome is determined not only by technical parameters but also by the body's reactive capabilities, primarily the immune system (2,4).

Failure to engraft fat with the formation of necrosis, cysts, indurations, and other complications, as clinical observations show, is not always explained by anatomical or surgical factors but may be related to the individual immunological characteristics of the patient (3,4).

**The aim of the study** was to conduct a comprehensive investigation of systemic and local changes in the immune profile in patients undergoing lipofilling with varying clinical outcomes.

**Material and Methods.** This study assessed the incidence of lipofilling complications in a control group of 93 patients who did not undergo immunological prognostication or prevention. Analysis of the distribution of adverse outcomes by anatomical sites of intervention revealed a clear correlation between the incidence of complications and the location of fat graft injection.

**Results and discussion.** The lowest complication rate was recorded for facial lipofilling, with 4 cases out of 24 (16.7%). A significantly higher complication rate was observed for breast lipofilling, occurring in 17 out of 37 cases (45.9%). Clinically, these patients experienced the formation of dense masses, swelling, and asymmetry. In some women, cysts or lipogranulomas were verified by ultrasound, and in some cases, aspiration biopsy was performed. Comparable complication rates were also observed for gluteal lipofilling. Of the 21 procedures performed on the gluteal region, complications were noted in 9 cases (42.9%). In this segment, the main complaints were the formation of dense masses, tenderness upon palpation, and volumetric asymmetry. In areas conditionally classified as "other" (including the dorsum of the hands, anterior abdominal wall, and pubic area), complications were observed in 4 of 11 cases (36.4%). Overall, the adverse outcome rate in the control group was 36.6%. The obtained data serve as a baseline clinical picture against which the immunological characteristics of patients and the types of morphological changes in complicated cases will be compared.

In the first stage, a comparative analysis of the cellular immune status in patients who underwent lipofilling, depending on the clinical outcome of the procedure, as well as in relation to a reference group of healthy individuals, revealed that the CD3<sup>+</sup> T-lymphocyte level, reflecting the overall T-cell component of the immune system, did not demonstrate statistically significant differences between the groups. This may indicate the preservation of the overall T-cell pool in both patients without complications and in those who subsequently developed adverse lipofilling outcomes. Similarly, CD19<sup>+</sup> B-cell counts remained within physiological norms in all subgroups, with no significant fluctuations, suggesting a limited role for the humoral component of adaptive immunity in the pathogenesis of outcomes. Differences in the CD4<sup>+</sup> to CD8<sup>+</sup> T-cell ratios attracted the most attention. In patients with unfavorable lipofilling outcomes, significant immunological changes were observed, including increased CD4<sup>+</sup> counts, decreased CD8<sup>+</sup> and NK cells, and an increased CD4<sup>+</sup>/CD8<sup>+</sup> ratio, which may be considered markers of subclinical immune dysregulation.

To assess the prognostic value of systemic inflammatory markers and cytokines before lipofilling, a comparative analysis of serum levels of IL-6, IL-10, TNF- $\alpha$ , TGF- $\beta$ 1 and CRP was performed in patients with different clinical outcomes, as well as in healthy reference individuals.

Levels of TNF- $\alpha$ , a key proinflammatory cytokine of innate immunity, were also elevated in patients with complicated outcomes. The average TNF- $\alpha$  level in this group was  $9.2 \pm 2.7$  pg/ml, significantly exceeding both the reference group ( $p < 0.01$ ) and uncomplicated patients ( $p < 0.01$ ). This directly indicates underlying activation of the proinflammatory cascade, predisposing to an overreaction to local changes in the transplantation area. For example, patient B., 44, with a TNF- $\alpha$  level of 10.6 pg/ml preoperatively, developed painful infiltration just 6 weeks after buttock lipofilling, requiring aspiration and subsequent surgical drainage.

Of interest are the levels of TGF- $\beta$ 1, a key regulator of fibrosis and tissue remodeling. In the group with complications, its level was  $3.8 \pm 1.0$  ng/ml, which is significantly higher than in the reference group ( $p < 0.05$ ) and higher than in patients without complications ( $p < 0.05$ ). In contrast, the level of IL-10 (an anti-inflammatory regulatory cytokine) did not differ significantly between the groups. In patients with complications, IL-10 was lower than in healthy patients, but did not reach statistical significance ( $p > 0.05$ ). This may indicate insufficient anti-inflammatory compensation in some patients, but requires further analysis in larger samples.

CRP levels also showed a consistent trend. Thus, with normal values in healthy individuals at  $1.2 \pm 0.4$  mg/l and moderately elevated in patients without complications, CRP in the group with an unfavorable outcome increased more than 2-fold ( $p < 0.001$ ), which may indicate the presence of subclinical inflammation prior to the intervention.

Thus, preoperative elevations in IL-6, TNF- $\alpha$ , TGF- $\beta$ 1, and CRP may be considered an immunological predisposition to the development of lipofilling complications.

The conducted correlation analysis revealed consistent functional links between cellular immunity disturbances (especially CD4<sup>+</sup>/CD8<sup>+</sup>, CD4<sup>+</sup>, NK) and increased inflammatory cytokine responses (IL-6, TNF- $\alpha$ , CRP). These data confirm that preoperative immune imbalance may be a key predictor of adverse lipofilling outcomes and should be considered when planning preventive measures.

To establish the anatomically specific immunological changes in patients with complicated lipofilling outcomes, a comparative analysis of significant immune parameters was conducted depending on the location of the procedure.

The most pronounced changes were observed in patients who underwent breast lipofilling. This group demonstrated the highest levels of IL-6 and CRP, which significantly differed from similar values for facial lipofilling ( $p < 0.05$ ). These differences indicate the most pronounced systemic proinflammatory activity in patients who had fat tissue injected into the mammary glands, which is likely related to both the vascular bed and tissue resistance in this area, as well as hormonal reactivity. Thus, the most pronounced deviations in significant immunological parameters in complicated lipofilling outcomes are observed in the mammary gland area. These data may directly indicate the high anatomical and functional vulnerability of this area to impaired fat graft engraftment under conditions of subclinical immune activation.

A clinical and immunological study revealed that patients with complicated lipofilling outcomes already had pronounced signs of subclinical immune imbalance preoperatively. The most significant differences in the complicated group were elevated levels of IL-6, TNF- $\alpha$ , CRP, and TGF- $\beta$ 1, increased CD4<sup>+</sup> lymphocyte counts, and the CD4<sup>+</sup>/CD8<sup>+</sup> ratio, along with decreased CD8<sup>+</sup> and NK cell counts. Significant positive correlations were also established between cellular and cytokine components of the immune system, increasing from reference values to complicated outcomes.

The most pronounced immunological disturbances were observed in breast lipofilling, consistent with the high clinical complication rate in this area. The data obtained confirm the presence of an immunological predisposition to an unfavorable outcome and can serve as the basis for developing a risk prediction system.

### **Conclusions:**

1. A clinical and immunological study showed that patients with complicated lipofilling outcomes already had pronounced signs of subclinical immune imbalance preoperatively.
2. The most pronounced immunological disturbances were observed during lipofilling of the mammary glands, which corresponds to the high clinical complication rate in this area. The data obtained confirm the existence of an immunological predisposition to an unfavorable outcome and can serve as a basis for developing a risk prediction system.

### **Literature**

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