

Lipofilling – restoration of balance of the facial adipose tissue

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Abstract

Aesthetic medicine offers a very wide range of beauty treatments. However, most of the filling substances (e.g. hyaluronic acid, calcium hydroxyapatite, polylactic acid) are absorbed with time and thus require replenishment. Treatments should be repeated at different time intervals. Moreover, such treatments depend on the intra-tissue administration of different substances that improve the appearance and exert rejuvenating effects albeit are simply foreign bodies. Alternatively, the patient's fat can be used as a filling substance.

Autologous adipose tissue transplants are called lipofilling. The method is extremely safe as the patient's own tissue is transplanted, which eliminates the risk of rejection. In other procedures with fillers, the substances used are foreign materials and generate the risk of inflammatory conditions. Therefore, an ideal alternative is to use the patient's fat for filling, i.e. adipose tissue autotransplantation.

The tissue needed for the procedure, is obtained by excision or liposuction of the adipose tissue from fat deposits using cannulas. Subsequently, the collected material is centrifuged, decanted and injected into the area requiring correction. Noteworthy, in aesthetic and cosmetic medicine, the fatty tissue is considered a free transplant that has to be incorporated into the surrounding tissues (the affected area) and therefore, the volume of fat transplanted during one procedure cannot be large. Nevertheless, it is a living tissue, which will live normally and remain permanently in the new area.

Fat transplants reduce wrinkles that appear with age, stimulate, rejuvenate, smooth the skin and correct various asymmetries and defects, which improves the skin tonicity and significantly enhances microcirculation; thus, the skin becomes well-toned, youthful and much smoother. The use of the patient's own tissue causes no allergic reactions and no risk of rejection. Such a transplant does not lead to any inflammatory reactions around the transplanted fat tissue.

Key words: lipofilling, adipose tissue, transplant, improvement, microcirculation, inflammatory reactions

Until recently, aesthetic medicine has offered only the removal of excessive adipose tissue; at present, the removed fat can be appropriately used for lipofilling, also called lipomodelling or lipotransfer [1].

Lipofilling involves the collection of the patient's (autologous) adipose tissue, its special preparation, and injection. Importantly, the tissue

is transplanted with the stem cells. In aesthetic medicine such procedures are often called „the restoration of balance of the facial fatty tissue”, although some other body regions can also be subjected to lipofilling.

For years, the above method has been commonly used worldwide for body or face modelling. Previously, the procedure was successfully used in

reconstructive surgery, i.e. restoration of the tissue volume lost after injuries. Today, lipofilling is also applied in aesthetic medicine.

1. History of autologous adipose tissue transplants. Although the adipose tissue transplants have been introduced quite recently, they are not a novelty. The procedure was used for the first time more than 100 hundred years ago; in 1892, Neuber, a German surgeon, applied this method to restore volumetrically the facial soft tissues [2]. He used blocks of the adipose tissues, about 1 cm in diameter, which he excised from the subcutaneous tissue of the arm region. His attempts, however, were not fully successful as in the majority of cases, ischaemia and necrosis of the central transplant fragment developed, which resulted in the substantial volume loss within several months. Similar observations were reported by Peer (1950) [3], although his results were slightly better and even 50% of fatty blocks was preserved after one year.

Moreover, fat autotransplants have been widely used in thoracic surgery. The first procedure was described by Vincenz Czerny in 1895 [4]. Subsequently, fat autotransplantation was adapted by other physicians (Wredde 1915, Lexer 1917 and Passot 1930) for breast augmentation. In the 40ties and 50ties of the previous century, most breast augmentations were performed using this technique. In those days, the fat was implanted surgically, which was associated with postoperative scars and significant inflammatory complications. Infections and necrosis were common and the transplant itself was relatively quickly absorbed or atrophied [5,6].

It is generally accepted that adipose tissue transplants using fine injections were initiated by Bruning in 1911. He excised small fragments of the adipose tissue, placed them in the syringe with a large bore needle, and injected into the previously determined place. Thanks to that, no surgical incision, which is much more invasive,

was required. His method, however, was not widely approved [3].

In 1950-1970, next novel ideas were introduced, i.e. injection of the synthetic material instead of the human adipose tissue. Paraffin or liquid silicon was used for such purposes. For some years, this method seemed superior as to the later outcomes. However, due to an increasingly high number of reports demonstrated postoperative complications, the method was abandoned [5,7].

In the 80ties of the previous century, a new revolutionary method of fatty tissue modelling was introduced, which involved liposuction. Many surgeons (Illouz, Chaichir, Bezaquen, Fournier, Coleman) started to transplant the sucked fatty tissue into various pathologically altered or post-trauma places [7].

Although the history of fat transfer techniques is long, only in the last two decades lipomodelling became technically sophisticated and safe for patients.

Nowadays many types of procedures with autologous adipose tissue are applied, which differ in technical details. According to Bieńka [3], there is no consensus regarding the duration and stability of the effects obtained after such reconstructions. Nevertheless, many surgeons introduced some modifications, such as centrifugation, cleansing and special preparation of the tissue for autotransplants, which markedly increased the safety (elimination of complications) and improved final outcomes [8,9]. The earlier methods relied rather on artistry, a simple method of collection and immediate implantation of the intact fat than on a precise anatomical algorithm and preparation of the autotransplant; therefore, the results were often unpredictable and poor, not to mention numerous inflammatory and other complications.

The methods based on fat transplantations are still of interest to many dermatologists and surgeons,

thus are continuously improved. Moreover, the indications for their use are increasingly wide.

2. Lipofilling purposes. Lipofilling can be used for almost all, even the most delicate body areas. The procedure is most commonly performed for filling and elimination of deep wrinkles, face modelling and lifting (in cases of volume and natural oval loss, moderation of the bone tissue contour, correction of asymmetries and shape - the soft tissue deficits are supplemented), restoring the primary skin volume in the regions of cheeks and a veil of tears, correction of the chin shape, lip augmentation, moisturisation, and revitalisation of the face and neck skin.

Similar effects are achieved in body modelling (correction of body contours) in which the selected body regions can be freely shaped to provide aesthetic and rejuvenated appearance of the entire silhouette. Such procedures include breast augmentation, modelling of the neck, trunk, abdomen, buttocks, calves, or even protruding foot bones. At present, correction of the dorsal parts of hands or female sexual organs is increasingly popular. Moreover, the method is used for breast toning, breast reconstruction after cancer-related amputations or managing post-burn atrophic scars. The other indications include contour defects of the subcutaneous tissue (filling post-traumatic or postoperative defects, volumetric reconstruction), e.g. tissue atrophy due to Romberg disease, circumscribed scleroderma as well as injuries and excessive liposuction [5,10].

The fat used in this method can be collected from any body region by liposuction. However, abdominal and thigh areas are most commonly selected. It is essential to transplant the fatty tissue to maximally reduce the damage of the injected fatty cells and provide the optimal conditions for their complete incorporation.

3. Methods and course of lipofilling. A delicate, atraumatic surgical method and aseptic conditions

are generally accepted for such procedures. As far as the individual stages of procedures are concerned, numerous authors suggest to follow the general pattern with some modifications and improvements introduced by the operators themselves, regarding the selection of the donor site, form of anaesthesia, method of transplant retrieval and its preparation (i.e. sedimentation and condensation), and method of injecting an implant. In general, various lipofilling procedures combine lifting and slight modelling of the areas selected for improvement and reconstruction. The procedures of lipofilling are divided into three main stages [3]; a single procedure, generally considered a major one, is performed during one day.

Stage I. The first stage is to collect the patient's fat under general or local anaesthesia. This stage is a classical liposuction. Firstly, the adipose tissue to be collected (e.g. from the abdomen, hip, thigh or knee region) is injected into the solution containing physiological saline, lidocaine and adrenaline. The solution is to soften the fat and constrict the local blood vessels. Subsequently, the skin is incised and the cannula inserted through which a suitable amount of fat is sucked using a syringe or a vacuum pump; about 20-30 ml of fat is normally collected on a one-off basis.

The location of the donor site is extremely important. Many authors believe that thighs are better than buttocks or the abdomen as the pain is lesser and the knee fatty cells are larger and show higher lipogenic activity. In many cases, the selection of the site is based on the patient's history; the patient should be informed that the most appropriate places are those most insusceptible to slimming.

According to the current recommendations, the fatty tissue should be collected using 10-60 cm³ syringes with a 2-2.5 mm needle or a 2-4 mm cannula. This procedure enables to obtain the fragments of fatty tissue of about 2 mm in diameter without damaging those vulnerable cells [3,11,12].

Some physicians recommend to leave the syringes in a perpendicular position for about 10 minutes, which results in the accumulation of the liquid phase (i.e. blood mixed with the anaesthetising solution) in their lower part and can be easily and quickly removed using the piston. In the upper part located above the proper fat, the thin liquid layer accumulated, which is mainly composed of fatty acids. This layer should be poured out after the piston removal [5]. According to Sattler, the syringes should be left in a container with hygroscopic gauze tampons in which the excess of fluid will be absorbed. Then the accumulated dense fibres of the connective tissue should be mechanically removed and the dense fraction poured into 1 ml syringes that will be used for direct injections or to 5 ml syringes used for freezing the collected tissue for potential further supplementary procedures [12]. Fournier and Sattler have suggested freezing of the fatty tissue for re-implantation (one time or multiple times), if needed. Re-implantation is possible after several weeks or a year at most [11,12].

The fat collected for re-procedures should be preserved by slow freezing to -20°C immediately after collection, which does not affect their survival. Thanks to slow freezing, the survival of cells can be even several years. Otherwise, very quick freezing (e.g. by immersing in liquid nitrogen) leads to unproductive fat decomposition. Noteworthy, the majority of authors do not recommend longer storage than 6-12 months [3].

Stage II. The second stage of lipofilling involves special preparation of the adipose tissue collected. Firstly, water, blood, an anaesthetic or impurities and dead cells are separated from fully valuable fatty and stem cells. Only the latter are capable of being accepted at the new site of transplant. Appropriate preparation of the adipose tissue enables also to anticipate future effects when the fat with stem cells is separated during horizontal centrifugation [10].

In previous years, this stage was not used and an extremely high number of cells was absorbed by the body. In some cases, the outcome was very poor as a substantial proportion of the transplanted tissue was markedly reduced [7]. Moreover, this stage ensures the presence of living stem cells, thanks to which the tissue regenerates quickly, the patient's general condition is very good, and the skin in the affected region is toned up.

Before its application, the separated (centrifuged) fat should be combined with autologous platelet-rich plasma in a strictly defined proportion. The plasma material is earlier collected from the patient's blood, centrifuged and purified of excessive fluids and impurities. As a result, clean fat containing stem cells is obtained. Over the trial-and-error years, this injective form has been demonstrated to be most abundant in the stem cells and most suitable for transplants [10].

Stage III. The third stage of lipofilling is the proper transplant of the collected and appropriately prepared adipose tissue. The preparation is injected into the site to be corrected. Before injection, the patient is locally anaesthetised, which also minimises potential bleedings within this area. According to Bienka, since the 90-ties of the previous century when the local anaesthesia with extremely diluted and neutralised local anaesthetics (tumescence anaesthesia) was popularised, this method has been found superior by many operators (the method of choice) due to its quick effects, simplicity, safety and lower incidences of bleedings [3].

Similar to earlier collection of fat for transplants, very thin and thus minimally invasive cannulas are used during this final stage (fat is introduced into the skin using a cannula and a syringe) [5].

Depending on the needs and nature of a particular defect, transplants of autoimmunologic adipose tissue are placed in various places, i.e. the dermis, the skin-subcutaneous tissue border or the

subcutaneous tissue. However, dermis transplants are rare mainly due to technical difficulties and unsatisfactory final effects. The injection can also be multi-layered, e.g. into the subcutaneous tissue, muscles and ligaments, perimuscularly, i.e. into the muscles and tissues in their vicinity. In each of the options mentioned, to achieve ideal aesthetic correction, injections should be made directly under the lesions. Point or linear injections are performed; over larger areas, plane injections are required. The examples of plane injections are total face lipofilling or fat autograft muscle injection [13,14].

The fat transfer into the subcutaneous layer is the most popular method; fat is injected directly under the dermis. Multi-plane transplants are less commonly recommended (into the subcutaneous layer or intraligamentously or muscularly). However, the above transfers ensure the most significant filling [15]. Some authors use intra- and peri-muscular injections; yet in such cases the risk of perioperative complications is higher and such methods are not recommended, at least for inexperienced operators [14].

To introduce fat under the skin, the lever syringes or 1-2 cm³ syringes are recommended. The syringes are attached to 1.5-2 mm needles (no.12), although many authors consider blunt syringes or special cannulas superior. Noteworthy, when the dermis is injected, thinner needles should be used (no. 0.6-0.7). In cases when quick absorption of the transplant part is anticipated, the majority of authors recommend to inject the tissue volumes about 30-50% larger than those desirable [15]. To avoid periodic deformities of the affected places, particularly when the face is injected, some authors prefer injections in stages and without hypercorrection [16, 20].

Noteworthy, the art of ideal fat transfer involves the injection of only a small amount of the product, which should ensure direct surrounding of the transplant by the tissues favouring its growth

and healing of the affected site. This method also increases the survival of the injected adipose tissues. To achieve such results, autologous fat should be mixed with platelet-rich plasma (PRP) -Autologous Therapy PRP [17].

The duration of a lipofilling procedure ranges from 40 to 50 minutes while the effects are visible after 2-3 days.

4. Post-procedure management. After the procedure, antibiotics and/or anti-inflammatory drugs and analgesics should be used for some time to prevent potential inflammatory and other complications. Moreover, delicate massages are indicated which facilitate even distribution of the implanted tissue. Dressings are most commonly needed only during the first post-procedure day. The affected sites can also be left open. Follow-ups are required [3,5,7].

5. Lipofilling outcomes. Lipofilling is a natural alternative to the most popular procedures used earlier, in which chemical fillers or implants other than the patient's tissue have been injected. Moreover, the method is effective, slightly invasive, and very safe while the results are most natural. It is estimated that about 70% of the transplanted fat remains forever in the place of injection and only 30% is absorbed within the period of 6 months following the procedure [10].

It is particularly emphasised that the results of lipofilling regarding the reduction of wrinkles, indentations and flaccidity of eye regions as well as scar management are extremely natural and discrete. The exceptionally good results are achieved in eliminating the flaccidity of the skin and its lifting, which predominantly concerns the face and neck regions. The methods used to date have not resulted in such good results. Thanks to lipofilling, the general appearance and quality of the skin is improved and the results are visible for a markedly longer time, compared to the earlier methods [5].

Many authors have reported varied results, depending on the location of transplants yet their findings are inconsistent [3]. Good outcomes have been most commonly observed in the regions of the glabella, forehead, zygomatic bone, cheeks, naso-labial and marionette folds, chin, upper and lower eyelids [18,12,19]. As for the remaining body parts, the best results regard the mouth region and breasts. Otherwise, unsatisfactory and short-lasting effects are most common when the lips are filled [11,19]. Moreover, according to the general opinion, longer effects are reported after reconstruction and correction of the subcutaneous tissue and worse results regard the superficial changes, e.g. correction of post-acne scars [20,3].

The major issue is gradual absorption of the transplant. Infections are very rare as the transplant of the patient's tissue effectively eliminates this risk. Due to subsequent partial absorption of the transplanted fat, in some cases, multiple re-lipofillings are required. Nevertheless, long-lasting and permanent effectiveness of fat autotransplants are observed in many patients [10].

Generally, lipofilling is good for face modelling and provides satisfactory volumetric results. Such procedures are recommended for individuals who lost the tissue volume due to ageing, which manifests as sinking of some face regions, e.g. the temples, cheeks, or eye orbits. Moreover, lipofilling is most effective for filling wrinkles and creases, especially when the lesions are deep. Another asset of facial fat autotransplant is the elimination of eye shadows caused by sinking of the lower eyelids with age. Such transplants filling a veil of tears flatten the wrinkles and remove the eye shadows [3]. Less beneficial effects are found when lipofilling is applied to augment or model the lips [11]. The fat required for such procedures is mainly collected from the abdomen, thighs, buttocks, or hips. Importantly, a small amount of fat is needed in cases of face lipofilling, as compared to other body parts,

which is important because even thin individuals can be subjected to such procedures [3].

Advantages and safety of lipofilling. The major asset of fat transplants is the use of fully natural and patient's own material, which enables almost total prevention of any allergic reactions. Moreover, the fat transplanted is collected from another place, ensuring additional and visible effect of slimming, especially in cases of transplants into other body parts than the facial region, which, as already mentioned, do not require the collection of large amounts of the adipose tissue. Thanks to these two advantages, patients decide to choose this method of modelling the face and other body parts. For this reason, the combined procedures, such as liposuction and lipofilling are increasingly common. Furthermore, fat transplantation is simple, can be performed in the outpatient settings, and is well tolerated by patients.

Moreover, lipofilling is not only an aesthetic procedure but has some other advantages. According to specialists, the introduction of the fat prepared in such a way not only reduces the effects of skin ageing but also increases skin regenerative processes; therefore, the procedure can be successfully used to reduce scars, burns and radiation therapy-related lesions [1].

The aesthetic medicine surgeries are most commonly visited by patients wanting to reduce wrinkles and excessive, local accumulation of the fatty tissue (e.g. in the area of hips, abdomen and thighs) and the symptoms of cellulitis. Another reason is to shape and enhance the body contours by breast or buttock augmentation (sucking the fat from the thighs or the abdomen and transplanting it into the breast, buttocks, etc). Thus, liposuction combined with lipofilling is fully granted. Since such procedures are sometimes supplemented with integumental reconstruction or scaroplasty [21], this option is particularly important in cases of disfiguring scars within the face, neck and shoulder

regions. Fat autotransplants are increasingly popular among patients due to their complexity, i.e. simultaneous slimming and modelling (e.g. elimination of wrinkles or augmentation of some areas) of almost the entire silhouette.

Many physicians have stressed that patients undergoing such procedures do not sufficiently care about safety, which is related to still low awareness of possible side effects of failed aesthetic interventions. However, in lipofilling the fat is collected from the patient's body, the risk of allergic reactions or complications is actually none. The only limitations in such procedures regard delicate management of the collected tissue and the volume of fat retransplanted only one time. When the implant is too large, the cells can die or calcifications are likely to develop. Moreover, frequent re-procedures are unfavourable. Therefore, lipofilling is recommended to be repeated every 3 or 6 months and not more frequently.

Good practical-technical skills and detailed knowledge of anatomy are essential in lipofilling procedures. Transplants should be placed properly and precisely, more so that the fatty cells are extremely delicate and vulnerable. They are damaged or even destroyed unless suitably managed. Thus, really good results of autotransplants of the adipose tissue depend on most appropriate collection and transplantation of the material (avoiding mechanical injuries). Moreover, it is necessary to minimise the exposure of transplants to air, which eliminates the risk of contamination and increases tissue survival. Surgeries of aesthetic medicine following the above rules in 100%, provide exceptional results, without any complications during years of practicing (e.g. no infections, necrosis, cytosteatonecrosis, damage to the adjacent nerves, etc). According to Blugerman et al. [10], who performed 726 such procedures, their patients have never reported healthy-related problems [10].

6. Adverse side effects following lipofilling.

Adverse effects and complications are rare and usually harmless. After the procedures, the affected areas can be swollen or bruised for some time. Generally, such effects maintain for about 3 days, not for more than a week. In some cases, patients should not only use the drugs ordered and follow the instructions but also alleviate the post-procedure places, if needed, and cool them with some home measures. Moreover, in the initial period patients should avoid soaking the injection places with water and exposing them to sunrays. In cases of face lipofilling, mimics should also be limited. Once the symptoms subside, which does not take long, patients can return to their normal everyday activities [1].

The other undesirable side effects include mainly calcifications, inflammations, excessive atrophy of the adipose tissue transplanted. The first to are, however, very rare and are mainly associated with carelessness and lack of experience of operators performing the procedure. Gradual atrophy of fat, on the other hand, is unavoidable (although not complete as the larger amount of adipose tissues remains in the body [10]).

The inability to anticipate final and 100% effectiveness of the lipofilling procedure is its another disadvantage. Healing and survival of fat transplants are highly variable. According to some aesthetic medicine practitioners, face effects maintain for about one year, on average, which is comparable with the procedures using conventional fillers [3]. Similar conclusions were presented earlier by Fredricks [22].

7. Contraindications for lipofilling. Contrary to appearances, lipofilling is a serious surgical procedure with certain contraindications. Such procedures cannot be performed in diabetics, patients with cardiac diseases, viral hepatitis, hypothyroidism, coagulation disorders, and cancers. There are also transient contraindications,

mainly active infections and/or respiratory diseases, pregnancy and breast-feeding, some anticoagulants, active herpes or other skin infections. In cases of breast augmentation, modelling, or reconstruction with lipofilling, any suspected breast diseases should be histopathologically excluded. Moreover, extremely slim individuals should not undergo lipofilling since the suitable amount of adipose tissue cannot be collected from them [3,10].

Conclusions

At present aesthetic medicine prefers fat transplants in cases in which larger amounts of the material should be supplemented, e.g. deep wrinkles of naso-labial folds or frontal creases. The other indications include concomitant cheek atrophy as well as deep glabella and hand wrinkles. The amounts of fat can be substantially larger than the amounts of fillers, which is also beneficial due to high costs of fillers. In some body regions and due to specificity of some patients, traditional fillers are still preferred, e.g. in lip procedures, or lack of patient acceptance regarding several day-exclusion after the procedure [3].

In Poland, the cost of lipofilling significantly varies (several and more thousands), which can be discouraging for some patients. The requirements of Polish patients are increasingly high (quality of procedures, care and safety standards). Therefore, when the centre wants to carry out such procedures, it should meet high requirements and invest in costly devices and infrastructure. Treatment rooms should fulfil both construction-related and sanitary-epidemiological requirements. We should be aware that operating rooms significantly differ from treatment rooms. In the treatment room, surgeries under general anaesthesia should not be performed. Such rooms are also not equipped with air conditioning with laminar air inflow, which is a standard in operation rooms. Moreover, treatment rooms are usually

smaller and uncomfortable; therefore, they are not suitable for major procedures. When more invasive procedures are planned, suitably spacious rooms should be available, not to mention oxygen sources and vital function monitoring; clean rooms in which the surfaces are easily mopped and aseptic conditions are not sufficient. The centres that plan to perform complex procedures of modelling the entire body should have operating rooms. The equipments costs of one operating room range from 1 to 2 mln PLN [21]. However, it should be clearly stressed that lipofilling procedures are not always so costly, compared to older methods as they are less demanding, less invasive and easier to perform, which is undoubtedly another asset of this modern method.

References

1. Bednarczyk P., 28.03.2015 - *Lipofilling - reimplantacja tkanki tłuszczowej*, Polska Kosmetologia i Kosmetyka PKiK, Medycyna Estetyczna
2. Neuber F., 1983 - *Fettransplantation*, Chir. Kongr. Verhandl Deutsch Gesellsch Chir., 22, 66.
3. Bieniek A., 27.03.2015 - *Przeszczepy autogennej tkanki tłuszczowej*, Centrum Chirurgii Plastycznej, Dermatologicznej i Laserowej
4. Grochowska J., 2013 - *Artyści skalpela (wywiad z dr Zbigniewem Mazanem)*, Newsweek, 8-10.
5. Del Vecchio D., Fichadia H., 03 February 2012 - *Autologous Fat Transplantation – A Paradigm Shift in Breast Reconstruction, Breast Reconstruction – Current Techniques*, Edited by Prof. Marzia Salgarello, InTech Europe-China, 217-240.
6. Goldwyn R.M., 1978 - *Vincenz Czerny and the beginnings of breast reconstruction*, Plast. Reconstr. Surg., 61, 673-81.
7. Bircoll M, Novack B.H., 1987 - *Autologous fat transplantation employing liposuction techniques*, Ann. Plast. Surg. 18, 327-329.
8. Coleman W.P., 1991 - *Autologous fat transplantation*. Plast. Reconstr. Surg. 88, 736.
9. Matsudo P.K., Toledo L.S., *Experience of injected fat grafting*. Aesthetic Plast. Surg. 1988, 12 (1), s.: 35-38.
10. Blugerman G. Amar R., Schavelzon D., Pelosi M.A., Soto J.A., Chomyszyn A., Podda M.,

- Markowsky A.V., D'Angelo J.A., Moreno R.,2011- *Advanced Lipotransfer Techniques*, [W:] *Advanced Techniques in Liposuction and Fat Transfer*, Edited by Prof. Nikolay Serdev, InTech Europe-China 12, September, 153-180.
11. Fournier P.F.,2000 - *Grafting: My Technique*, *Dermatol. Surg.*26, 1117-1128.
 12. Sattler G., Sommer B., 2000 - *Liporecycling: a technique for facial rejuvenation and body contouring*, *Dermatol. Surg.* Dec, 26 -1140-1144.
 13. Donofrio L.M., 2005 - *Panfacial volume restoration with fat*, *Dermatol. Surg.*, 31, 1496-1505.
 14. Butterwick K.J., Lack E.A.,2003 - *Facial volume restoration with the fat autograft muscle injection technique*, *Dermatol. Surg.* 29, 1019-1026.
 15. Chaichir A., Benzaquen I., Wexler E. i inni, 1990 - *Fat injection*, *Aesthetic Plast. Surg.*, 13,127.
 16. Moscona R., Ullman Y. i inni, 1989 - *Free – Fat Injections for the Correction of Hemifacial Atrophy*. *Plast. Rec. Surg.*, 84,501-507.
 17. Mundy L.,2013-*Platelet-rich plasma for the treatment of knee osteoarthritis*, *Technology Brief*, Health Policy Advisory Committee on Technology
 18. Berman M.,2000 - *Rejuvenation of the Upper Eyelid Complex with Autologous Fat Transplantations*, *Dermatol. Surg.* 26:1113-1116.
 19. Eremia S., Newman N.,2000 - *Long-Term Follow Up after Autologous Fat Grafting: Analysis of Results from 116 Patients Followed at Least 12 Months After Receiving the Last of a Minimum of Two Treatments*, *Dermatol. Surg.* 26, 1150-1158.
 20. Ersek R.A.,1991 - *Transplantation of Purified Autologous Fat: A 3 – Year Follow – Up is Disappointing*, *Plast. Rec. Surg.*,87,219-226.
 21. Mieczkowski D.2010 - *Poszukiwane modelowanie ciała*, *Nowoczesna Medycyna Estetyczna*.
 22. Fredricks S., 1989 - *Dyskusja artykułu Chaichira i Benzaqewna: Fat-Grafting Injection for Soft-Tissue Augmentation*. *Plast. Rec. Surgery*, 84, 935.