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ACTA CHIRURGIAE PLASTICAE, 59, 2, 2017, p. 55

Dear colleagues,

Medicine would not progress without new data and we would not have new data without critical thinking and science. Science is accountable for any progress. We would still be using adipofascial grafts for breast augmentation, we would cease using silicone breast implants due to a fear of breast cancer or connective tissue diseases, we would not have any perforator flaps, and would not know any objective data on the quality of life of our patients or objective data on fat grafting performance.

The most important part of plastic surgeon's professional life takes place at the operating room. However, in order to achieve the best possible care of our patients, we need something more. We need to pursuit academic carrier, be active in science, publish or we are going to perish. The responsibility lies not only on the leaders of plastic surgery, but on each individual plastic surgeon, whether he or she just harvests fruits or is giving something back.

Continuous education of a plastic surgeon is a must. Without it, his or her skills would slowly become obsolete. In my opinion, the best education, that ensures staying up to date, is to create own content – teaching, presenting at conferences, writing books or articles. This forces people, even if they do not want to, to dig into archives of plastic surgery and to study newest available data on a particular subject. Therefore I encourage you to present or publish, for example in Acta chirurgiae plasticae, which is a journal with more than 50 years of tradition providing the newest content to Plastic Surgery Society.

Great news is that number of submissions to our journal increases along with their quality. Here we present second issue of the year 2017, which is full of interesting articles from renowned authors from several countries across the World.

Article by Dr. Bukovcan is discussing lower extremity wound complications in patients with warfarin use, their incidence and treatment approaches. Article by Elshazly and al. involves research that compares suture vs. glue for micro neural anastomosis on an animal model. Dr. Streit offers two articles in fat grafting topic. First one describes technique of breast reconstruction using extended latissimus dorsi flap and direct fatgrafting into latissimus dorsi and pectoral muscles. In the second article, he offers an overview of current concepts of autologous fat transfer to breast and face. Another overview is written by Dr. Kaiser describing current concepts in peripheral nerve injury repair. Di Lorenzo at al. describes author's preferred technique to correct labia minor hypertrophy using reduction of labia minora and fat grafting to labia majora. Last, but not least, article by Dr. Pilný describes case series of rare glomus tumor, including its diagnostics and treatment.

I wish you a pleasant reading.

Assoc. Prof. Ondřej Měšťák, M.D.

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COMPLICATIONS OF LOWER EXTREMITY HEMATOMAS IN PATIENTS WITH PRE-INJURY WARFARINE USE

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ACTA CHIRURGIAE PLASTICAE, 59, 2, pp. 56-59

ABSTRACT

Introduction. The aim of this paper is to ascertain the number of patients with pre-injury warfarin use who developed lower extremity hematomas treated in our facility, to analyse the data, used treatment methods and outcomes in these patients.
Patients and Methods: We performed a retrospective review, identifying all the patients with pre-injury Warfarin use admitted with hematoma or full-thickness skin loss in the ten years period from January 2006 to December 2015.
Results: Overall 9 women and 2 men with mean age of 72 years were identified. All the injuries were sustained in a domestic setting. Except of one female patient primarily admitted to our department, all patients had been hospitalized primarily in local/regional hospitals for an average period of 32.6 days. All the patients transferred to our department required surgical wound closure. The mean wound surface area was 136.3cm^2 (range 45-525). The duration of hospital stay was 15 days in average.
Discussion: The data obtained were compared with the results and findings of similar studies and were discussed.
Conclusion: The results achieved in the present study showed the beneficial effect of used treatment methods based on the surgical wound closure techniques during hospital stay of the patients. Clinicians, first contact physicians, and also patients alone need to be aware of the vulnerability of this group of patients. The consequences of even minor lower extremity trauma can be serious, with development of a very complex chronic wound that is difficult to manage.

KEYWORDS

Lower extremity hematoma, anticoagulated patients, chronic wound

INTRODUCTION

Warfarin is the most common oral anticoagulant used for chronic anticoagulation therapy, which is an integral part of the treatment in patients with various diagnoses in indicated cases[1,2] . Despite beneficial treatment effect, those patients can be vulnerable to possible post-traumatic complications, which may occur. Although complications of pre-injury Warfarin use have already been reported[3,4,5,6], lower extremity hematomas in patients with pre-injury Warfarin use are seldom mentioned in the literature. As a result of even minor lower-extremity skin injury, closed and open haematomas can occur, that can cause complications such as infection and full-thickness skin loss subsequently requiring surgical management. Our department has encountered patients with such complications. The aim of this study is to identify these patients, to analyse data, used treatment methods and outcome of these patients and to identify the risk factors for this type of complication.

PATIENTS AND METHODS

We performed a retrospective review of our registry data, identifying all the patients with pre-injury Warfarin use admitted with a hematoma or full-thickness skin loss in the ten-year period from January 2006 to December 2015. Demographic data, wound surface area, methods of wound closure, length of hospital stay in our department, length of previous hospital stay in other departments were obtained. Data are presented as the means ± standard deviation (SD).

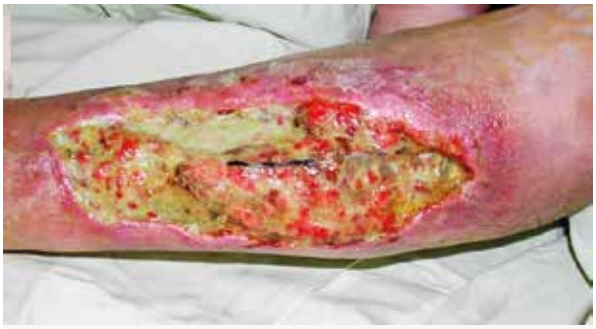

Figure 1. 72-year-old warfarinised female patient (atrial fibrillation) with defect of the left lower leg caused by infected haematoma created after an injury. Patient was transferred from another hospital 21 days post injury after incision and evacuation of the hematoma.

Figure 2.,3. Same patient after surgical debridement of the wound. Note the deep undermining of the wound

Figure 4. Wound appearance after 5 days of NPWT immediately before wound closure procedure. The undermined space is almost obliterated, wound surface covered by healthy granulation tissue

Figure 5. Healed wound 12 days after wound closure by split-thickness skin autograft. Softened skin margins with no oedema enabled partial suture proximally

A value of $p < 0.05$ was considered to represent statistical significance. The data obtained were compared with the results and findings of similar studies and were discussed. (Figures 1–5.)

RESULTS

Overall 11 patients, 9 women (82%) and 2 men (18%) with mean age of 72 ± 9.98 years (range 54–83) were identified in this retrospective review. In 7 patients, Warfarin was used in the management of chronic atrial fibrillation and in 4 patients for deep vein thrombosis. All injuries occurred in a domestic setting. Except of one female patient primarily admitted to our department with closed hematoma of the lower leg 14 days post-injury, all patients were hospitalized primarily in local/regional hospitals for an average period of 32.6 days where, after bridging anticoagulation with low-molecular-weight heparin, evacuation of the hematomas, debridement and, in three patients, also negative-pressure wound therapy had been performed. Subsequently, patients with defects requiring surgical wound closure were transferred to our department. All defects were localised on the lower extremity, including knee in two and ankle in one case. Measured on the day of admission to our department in each patient, the average wound surface area was 136.3 cm² (range 45–525 cm²). The wound surface was covered by slough in four patients, in one patient it was partially necrotic, in one patient the wound edges were deeply undermined. In the rest of the patients the wound surfaces were covered by clean granulation tissue. All 11 patients required surgical wound closure. In 10 patients the wound closure was obtained by split-thickness skin autograft. Due to inadequate wound condition for primary closure, three of them required two stage operation including negative pressure wound therapy in two and skin xenograft coverage in one patient respectively, for the coverage of debrided wounds in the first stage operation. Skin xenograft as a temporary biological skin substitute and negative pressure wound therapy in those patients had been used because the take of the skin graft was questionable. In the second stage operation skin xenograft or sponge had been removed and replaced by skin autografts. In one female patient admitted for closed hematoma of the lower leg 14 days after injury, incision, evacuation of the hematoma, insertion of the Redon drain and suture of the incision had

	Pt. No/ age	Gender	Localization	Wound surface area (cm^2)	Operation	Hospital stay (days)	Previous hospitalization (days)	Treatment time (days)
	No 1/ 54	Female	Knee	64	abrasion, AG	14	65	79
	No 2/ 67	Female	Lower leg	96	1/ debridement, XG 2/ AG coverage	16	52	68
	No 3/ 83	Female	Lower leg	180	abrasion, AG	10	27	37
	No 4/ 71	Female	Knee	45	1/ debridement, NPWT 2/ AG coverage	17	38	55
	No 5/ 72	Female	Lower leg	140	1/ debridement, NPWT 2/ AG coverage	21	21	42
	No 6/ 78	Female	Lower leg	70	incision, drainage, suture, NPWT	43	--	43
	No 7/ 80	Female	Lower leg	60	excision, AG	9	14	23
	No 8/ 78	Female	Lower leg	169	abrasion, AG	8	19	27
	No 9/ 72	Female	Lower leg	45	abrasion, AG	8	27	35
	No 10/ 55	Male	Lower leg, ankle	525	abrasion, AG	11	20	31
	No 11/ 82	Male	Lower leg	105	abrasion, AG	8	30	38
mean±SD	72±9,9			136,3±137,4		15,1±10,1	32,6±15,3	43,4±18,3

Table 1. Patients and results
Abbreviations: AG – split thickness skin autograft, NPWT – negative pressure wound therapy, XG – skin xenograft, SD – standard deviation

been performed. The outflow end of Redon drain was inserted into the foam dressing placed over the sutured wound, sealed by occlusive film dressing and attached to the negative-pressure unit, thus supporting simultaneously the drainage and healing of the wound. The length of hospital stay in our department averaged 15.1±10.1 days (range 8–43). At the end of hospitalization in our department, all the wounds were healed. In ten patients hospitalized previously in other facilities, the difference between the length of hospital stay in our department and the length of previous hospitalizations is statistically significant (paired t test, p=0.003). When adding the length of hospital stays in other facilities with the length of hospital stays in our department, the average treatment time was 45.9±16.5 days. The data and results obtained are shown in the Table 1.

DISCUSSION

Patients treated with warfarin are mainly in older age group, which corresponds fully with the mean age of the patients included in the study (72±9.98). They are represented also by skin vulnerability as ageing reduces skin elasticity, dermal anchorage and subcutaneous tissue. Except Warfarin use and the need of proper adjustment of dosage in therapeutic range, older people also have a higher risk of other factors predisposing to lower limb haematomas including falls, diabetes-related neuropathy, lower leg vascular disease. The predominance of women in our study can be explained by their greater activity in household tasks performance thus creating a greater chance to sustain an injury.

According to our point of view, lower extremity hematomas in our patients developed from a shearing injury, causing separation of the skin and subcutaneous tissue from muscle fascia. This created a space capable of filling with blood, causing high-pressure forces on the tissues potentially causing skin necrosis with development of a very complex chronic wound that is difficult to manage, particularly in the elderly patient with multiple concomitant comorbidities. According to the literature[7], the cases of 3 patients with intramuscular bleeding, who developed compartment

syndrome after sustaining very low-energy trauma while anticoagulated with warfarin were described.

Treatment of full-thickness lower extremity hematomas in anticoagulated patients with Warfarin was previously described in four elderly patients (77.2 ± 12.7 years) presented with full-thickness, necrotic, lower extremity wounds[8]. Wound dimensions averaged 19.1 cm ± 8.9 cm in length, 12.2 cm ± 9.5 cm in width. After initial debridement under local anesthesia, the patients were treated on the outpatient basis while maintaining therapeutic anticoagulation therapy with warfarin. Following primary short treatment with wet-to-moist saline dressing changes, continuous negative pressure therapy was for an average of 23.8 ± 3.2 days. All wounds were then treated with application of a living bilayered skin substitute ([LSS], Apligraf®, Organogenesis, Canton, MA) meshed 1.5:1 in an outpatient setting. Additional LSS application was performed if, after 6 weeks following LSS application, further epithelialization and closure of the wounds stalled. Authors decribe their near total outpatient treatment protocol as minimally disruptive to the patients' routines, while maintaining anticoagulation therapy with warfarin, although in two patients the cessation of anticoagulation therapy before inpatient operative debridement was described. All wounds completely epithelialized within an average of 39.0 ± 21.9 weeks from the initiation of therapy. Eventhough our patients were not managed on an outpatient basis but hospitalized and treated surgically, this is in contrast to our patient´s outcome with the average treatment time (including also hospitalization time in other facilities prior to the admission to our department) of 43.4±18.3 days. In comparison with near total outpatient treatment protocol described by the authors of compared study, with regards to the results achieved, we believe that our patients have benefited from shorter treatment time substantially reduced by surgical wound closure methods. Pertaining surgical treatment, there were no complications observed. To minimize the risk of complications, two-stage operative approach described in results was used in three patients with wound conditions unsuitable for definitive wound closure after the debridement. Our experience with negative pressure wound therapy, used in three of our patients, is in accordance with scientific evidence of its beneficial treatment effect by stimulation of blood flow, angiogenesis and granulation formation, derivation of soluble wound healing inhibitor substances from the wound area, mechanical forces pulling the wound edges together, reduction of tissue oedema and reduction of bacterial contamination[9].

Preinjury warfarin use has been demonstrated to be an independent predictor of mortality in major trauma patients[3], although the proper dosage of Warfarin is equally important[6].

As the indications for oral anticoagulation therapy have been broadened, increasing number of warfarinized patients may represent a risk of bleeding complications with possible hematoma occurence in a larger number of patients.

CONCLUSION

As it is shown in the manuscript, the consequences of even minor lower extremity trauma in patients with preinjury Warfarin use can be serious, with development of a very complex chronic wound that is difficult to manage, particularly in the elderly patient with multiple concomitant comorbidities. Therefore, clinicians, first contact physicians, and also patients alone need to be aware of vulnerability of this group of patients. According to our point of view, also the proper dosage of anticoagulant medication and the willingness of the patients to take part in the outpatient appointments to adjust the dosis of medication and keep it in therapeutic range is of paramount importance.

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SURGICAL CORRECTION OF LABIA MINORA HYPERTROPHY, A PERSONAL TECHNIQUE

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ACTA CHIRURGIAE PLASTICAE, 59, 2, 2017, pp. 60–64

ABSTRACT

Background. Labia minora hypertrophy is a congenital or acquired condition in which both labia minora (or more rarely only one) protrude beyond the edge of the labia majora. The authors present a surgical technique of volumetric reduction of hypertrophic labia minora, associated with lipofilling of the labia majora.

Methods. Between 2005 and 2014, 27 patients underwent surgical reduction of labia minora, as described by Altier and Rouzier. The indications for surgical treatment varied and were as follows: interference with sexual intercourse; poor hygiene; difficulty wearing tight-fitting pants; difficulty while performing sporting activities such as cycling; aesthetic complaints. The surgical resection was associated with fat graft injection in labia majora in order to protect and cover the labia minora. The mean follow up was 1 year.

Results. The labia majora, increased in volume and firmness, cover and protect the labia minora slightly hypertrophic or surgically reduced. All patients reported an improvement in comfort, aesthetic appearance, when wearing close-fitting clothes and an improvement in their sexuality. In one case we recorded a "recurrence", with an increase of dimensions in width of labia minora, still lower than the preoperative situation but greater than the immediate postop.

Conclusions. The reduction of labia minora hypertrophy with conservative techniques allows achieving excellent results in terms of aesthetics and functionality. The simple lipofilling of labia majora allows preserving and protecting the labia minora through a volumetric increase of the labia majora.

KEYWORDS

Labia minora hypertrophy; labia minora lipofilling; labiahypertrophy treatment

INTRODUCTION

The labia minora are two muco-cutaneous folds situated between labia majora. The hypertrophy of labia minora, originally described as protuberant tissue projecting beyond the labia majora, is a congenital or acquired pathological condition whose aetiology is not well known and in some cases may be due to chronic inflammation, exposure to exogenous androgens, use of urinary catheters in patients with spinal paralysis, specific sexual activities or continuous manual stretching in some primitive cultures [1,2]. This alteration of the anatomical shape of labia minora often causes discomfort for patients. The reasons why these women come to the doctor may be different. The protrusion of hypertrophied labia minora outside the vulvar vestibule, perceived as disgraceful by the patients, represent the most frequently reported motivation for consultation. There seems to be a correlation between the degree of hypertrophy and the incidence of resulting discomfort [3]. Young girls usually describe a discomfort with perception of a "bulge" in the underwear or bathing suite. They need to fold up and push the labia into vagina, in order to reduce the bulge [3]. Usually both labia minora are hypertrophic. More rarely hypertrophy is unilateral.

It is difficult to determine when a labium requires surgical correction. Friedrich [4] considers normal a labium that is less than 5 cm in width when pulled anteriorly. Other authors suggest that the normal width of labia minora should be less than 3–4 cm. The labia minora hypertrophy was classified by Franco [5] into grade 1 through 4 depending on the protrusion of the labia minora through the labia majora: grade 1, <2cm; grade 2, from 2 to 4 cm; grade 3, from 4 to 6 cm; and grade 4. Some patients associate the normally darker, corrugated appearance of the labial edge with an "aged" appearance and prefer to have it removed, regardless of its length or width. Chang et al described in 2013 a new classification system with four classes of labia protrusion based on size and location. [6] The labia minora should be fully extended and measured from midline to the lateral free edge during the physical examination. If the labia measure more than 4–5 cm, surgical correction can be planed but in the majority of cases the symptoms described by the patients are more important than measurements alone. In literature different techniques of labia minora reduction are described [7–15]. The most popular are:

1) The edge excision technique as described by Capraro [16] and Felicio [17], which simply involves amputation of protuberant tissue, thus removing the dark, corrugated labial edge.

2) The deepithelialization of the central portion of the medial and lateral surface of each hypertrophic labium and the direct suture of the margins with an absorbable monofilament suture 4/0, introduced by Choi and Kim [18].

3) The wedge resection of the central portion of hypertrophic labia.

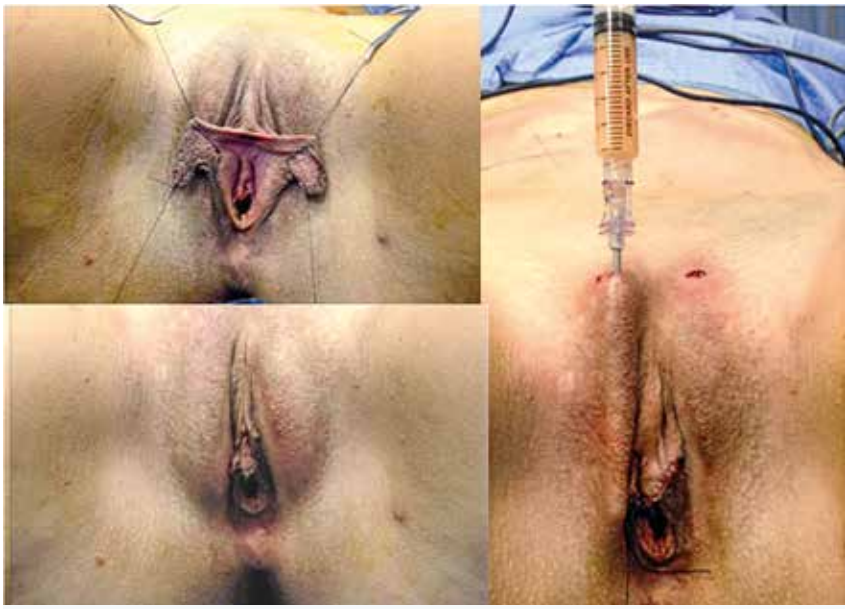

Fig. 1. *(Above left)* Pre-operative marking for labia hypertrophy correction. *(Below)* Lipofilling of labia majora. *(Above right)* Postoperative view at 6 months

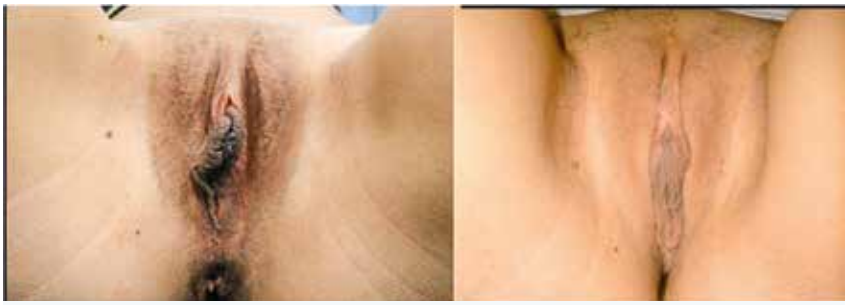

Fig. 2. *(Left)* Pre-operative view in a 27 years old patient. *(Right)* Post-operative view at 1 year

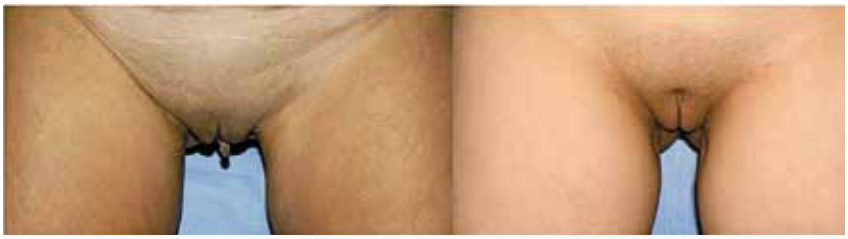

Fig. 3. *(Left)* Preoperative view in a 22 years old patient standing. *(Right)* Post-operative view at 15 months

4) The longitudinal amputation of the hypertrophic segment through double w-shaped interdigitated complementary incisions. It is indicated in cases of severe hypertrophy. The interdigitated suture avoids the problem of scar retraction of a linear suture [19].

5) The superior pedicle technique with inferior wedge resection as described by Alter (20) and modified by Rouzier et al [21].

6) Laser labioplasty with ablative lasers (Nd Yag). [22]

The authors present their experience with labioplasty described by Alter and Rouzier plus lipofilling of the labia majora.

The association of labioplasty and lipofilling is described here for the first time.

MATERIALS AND METHODS

Between 2005 and 2014, 27 patients underwent surgical reduction of the labia minora in our institute (Table 1). Surgical treatment was requested by 6 patients in order to correct the hypertrophy with related functional problems and to improve labia minora appearance. The reasons for surgical treatment varied and were as follows: interference with sexual intercourse; poor hygiene; difficulty wearing tight-fitting pants; difficulty performing sporting activities such as cycling; aesthetic complaints.

Regarding aetiology, all patients had congenital labia minora hypertrophy. All patients reported worsening of hypertrophy over the years and complained of the aged appearance of their external genitalia. The surgical procedure was bilateral in 26 patients and unilateral in one patient. The average age of the patients was about 32 years (from 16 to 45).

The labia minora of all patients measured 4 to 6 cm in width and thus were grade 3–4 according to the classification of Franco. In all patients the wedge resection of labia minora was associated with lipofilling of labia majora. The aim of the surgery was to achieve coverage of the labia minora with labia majora.

All procedures were performed with sedation and small amount of local anaesthesia, in order to avoid modification of the shape of labia minora before incision and to minimize the discomfort of the patients. In the operating room, patients were placed in lithotomic position. The labia were fully extended and measured. The inferior wedge was marked. The angle and the extent of the wedge vary, depending on the tissue excision and the cutaneous-mucosal laxity. After the infiltration with local anaesthetic plus adrenaline, the inferior wedge resection was performed leaving a superior pedicle flap with a rich blood supply, as described by Altier and Rouzier. Haemostasis is easily achieved; the superior pedicle labial

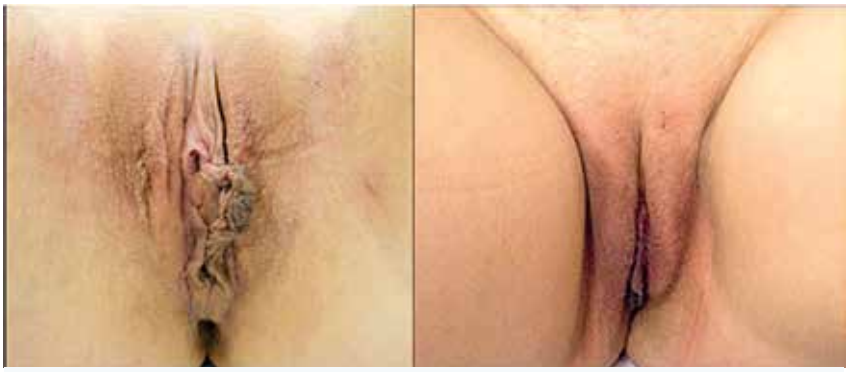

Fig. 4. *(Left)* Preoperative view in a 34 years old patient. *(Right)* Post-operative view at 10 months

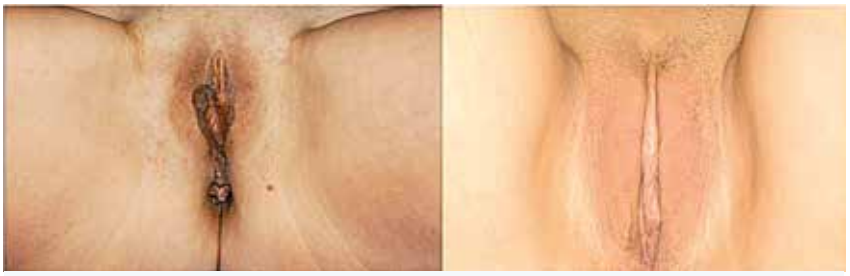

Fig. 5. *(Left)* Preoperative view in a 31 years old patient. *(Right)* Post-operative view at 12 months

Fig. 6. *(Left)* Preoperative view in a 32 years old patient. *(Right)* Increase of dimensions of labia minora after about 10 months from the surgery

flap is gently spread and sutured inferiorly without tension with absorbable interrupted stitches. Furthermore, care must be taken to avoid wide undermining and haemostasis near the base of the superior flap because the vascular supply comes from this region. Surgery does not require the placement of a urinary catheter (two cases only) or vaginal packing, or the administration of systemic antibiotic therapy. Patients were discharged home the same day of the surgery; they were seen after a week to change the dressing. Postoperative care include perineal hygiene and analgesic. Postoperative pain was reported by 8 patients. It is usually treated with NSAID (nonsteroidal anti-inflammatory drugs) at least for one week. Most of the patients complained of burning sensation for about ten days. Frequent washing with antiseptic solution and cold water relieved this symptom. Wound dehiscence was observed in 3 patients. Only one patient required surgical correction under local anaesthesia. No infection was observed. All patients reported post-operative dyspareunia (the pain lasted for up to 5 weeks).

The wedge resection of labia minora was associated with lipofilling of labia majora in order to protect and cover the labia minora (Fig. 1). Lipofilling of the labia majora is a technique of external genitalia rejuvenation. The adipose tissue was harvested from the abdominal region by means of liposuction technique. The surgeon chose abdominal region because of the quantity of fat and the simplicity of the technique. Donor sites were infiltrated with tumescent solution, and fat was harvested using a 3-mm Luer-lock cannula under low pressure in 20 ml syringes. Fat was then collected in 10 ml syringes, and oil and serum were decanted before centrifugation. The harvested fat samples were centrifuged at 3000 rpm for 2–4 minutes. The goal was to obtain a homogeneous "paste" that could be easily and predictably injected. Oil and serum were again fractionated and decanted. Viable fat cells were placed in 10 ml syringes in preparation for injection. Less fibrous fat has better flow characteristics, permitting smoother infiltration.

It is important to be aware of the flow characteristics of the fat, which is injected to prevent irregularities, and to ensure that specimens of similar quality are used symmetrically. About 35-50 ml of adipose tissue are injected on the free edge of every labium major through a single skin incision located in the vulva.

The labia majora increase in volume and firmness, cover and protect the labia minora, which are surgically reduced (Fig. 2–5).

Patient	Age	Width (cm) of labia minora	Complaint	Outcome	Complications
1	34	4	Aesthetic complaints, difficulty wearing tight pants	Satisfied	None
2	45	4,5	Aesthetic complaints	Satisfied	None
3	40	4	Aesthetic complaints, chronic inflammation and pain	Satisfied	None
4	31	3,5	Aesthetic complaints	Satisfied	None
5	28	5	Aesthetic complaints, interference with sexual intercourse	Satisfied	None
6	27	4,5	Aesthetic complaints, difficulty wearing tight pants	Satisfied	None
7	33	3	Aesthetic complaints	Satisfied	None
8	41	3,5	Aesthetic complaints, Interference with sexual intercourse	Satisfied	None
9	23	5,5	Aesthetic complaints, chronic inflammation and pain	Satisfied	None
10	29	4	Aesthetic complaints	Satisfied	None
11	42	4,5	Aesthetic complaints, dyspareunia	Satisfied	None
12	44	5	Aesthetic complaints	Satisfied	None
13	38	5,5	Aesthetic complaints, difficulty wearing tight pants	Satisfied	None
14	32	6	Aesthetic complaints, dyspareunia	Unsatisfied	Recurrence
15	16	3,5	Aesthetic complaints	Satisfied	None
16	18	3	Aesthetic complaints	Satisfied	None
17	32	4	Aesthetic complaints, difficulty wearing tight pants	Satisfied	None
18	35	4,5	Aesthetic complaints	Satisfied	None
19	44	5,5	Difficulty performing sporting activities	Satisfied	None
20	40	6	Aesthetic complaints	Satisfied	None
21	34	5,5	Aesthetic complaints, difficulty wearing tight pants	Satisfied	None
22	27	5	Aesthetic complaints, poor hygiene	Satisfied	None
23	17	3,5	Aesthetic complaints	Satisfied	None
24	44	4	Aesthetic complaints	Satisfied	None
25	31	3	Aesthetic complaints, difficulty wearing tight pants, poor hygiene	Satisfied	None
26	20	3,5	Aesthetic complaints, chronic inflammation and pain	Satisfied	None
27	22	4	Aesthetic complaints	Satisfied	None

Table 1. Summary table

RESULTS

The mean follow up was 1 year. All patients reported an improvement in comfort aesthetically, when wearing close-fitting clothes and improvement in their sexuality. In one case we recorded a "recurrence" with an increase of labia minora width, still lower than the preoperative situation but greater than the immediate postoperative status (Fig. 6). Probably this is due to the manual stretching of the patient during the days following the operation, which led to a dehiscence of the sutures and a secondary wound healing.

DISCUSSION

The high degree of satisfaction reported by the patients support the use of this procedure. The surgery is short-lived, can be performed under sedation and local anaesthesia as outpatient surgery, does not require urinary catheterization or vaginal packing and helps to improve the quality of patients' life.

Careful haemostasis and personal postoperative hygiene reduce the incidence of immediate complications such as a hematoma, wound dehiscence and infections.

Late complications described in literature are the retraction of the scar, neuroma-like hypersensitivity and relapse. The scarring and retraction with consequent advancement of the rear fork and vaginal narrowing of the introitus is a rare complication. In most cases it happens due to a technical error of re-approximation of the skin flaps to the rear fork. In our series of patients, scarring was not significant or symptomatic and did not alter the final appearance of the labia minora. The risk of flap necrosis is minimal with this technique, considering the labia vascularization [23].

The recurrence rate is very low and occurs practically only in patients who continue to perform mechanical stretching of the resected lip (1 patient in our series). The wedge resection preserves the free edge of labia minora, so its natural

appearance and sensitivity. In cases of large hypertrophies, which extend posteriorly, resection should be limited and should not extend too far posteriorly to avoid that the scars alter the vaginal introitus causing persistent discomfort and post-operative pain. In our cases, associated with the wedge resection of labia minora, the lipofilling of the labia majora helps to protect the labia operated but still hypertrophic in its posterior part. The increase in volume of the labia majora not only protects and covers the labia, but also greatly improves the aesthetic appearance of the vulvar region, giving a greater firmness and a more youthful appearance.

CONCLUSIONS

Reduction of the labia minora hypertrophy with conservative techniques that preserve the colour and the natural contour of the labia minora allow achieving excellent results in terms of aesthetics and functionality. Despite there was no technique described in literature to be superior to the others with regards to the outcomes and complication rate, labioplasty with inferior wedge resection and superior pedicle flap in our experience provides a better aesthetic result by preserving the pigmented free edge of the labium, its sensibility and vascularization with a low rate of complications and the simple lipofilling of labia majora allows to preserve and protect the labia minora through a volumetric increase of the labia majora. The surgical procedures in almost all cases yielded results, that were satisfactory from the aesthetic point of view and exceptional from the functional point of view, allowing the patients to perform normal physical and sexual activity.

Acknowledgment

The authors declare that they have no conflicts of interest to disclose.

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SUTURE VERSUS FIBRIN GLUE MICRONEURAL ANASTOMOSIS OF THE FEMORAL NERVE IN SPRAGUE DEWLY RAT MODEL. A COMPARATIVE EXPERIMENTAL ASSESSMENT OF THE CLINICAL, HISTOLOGICAL AND STATISTICAL FEATURES

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ABSTRACT

Introduction. Peripheral nerve injury is a frequently encountered clinical problem that leads to functional losses at the long--term. Although microsurgical repair has been introduced to clinical practice in peripheral nerve injuries, unsatisfactory outcomes regarding functional recovery in target organ cause an increasing interest on studies about nerve injury and biology of the recovery in nerve injuries1.
Material and Methods. Sciatic nerves of seventy adult Sprague Dewly rats were transected and primary anastomosis was performed. Rats were then divided into three groups: Control group, while 30 rats were repaired with sutures, and the remaining 30 were repaired with fibrin glue. After 30 days the rats were sacrified and the sciatic nerves were investigated histologically with morphometrical and statistical analyses.
Results. In microsurgical nerve repair, suture placement has been thought to cause hindrance to the sprouting axons and compress the blood supply to the fascicles, thereby impairing the regeneration of the transected nerve ends after repair, with possible neuroma formation. On the other hand, fibrin glue is a simple, effective technique, less time consuming than suturing. Another advantage of this suture-free technique is that it avoids injuring the axon with needles, and the lack of foreign bodies minimizes the inflammatory reaction.
Conclusion. We recommend using fibrin glue as it demonstrates less inflammatory reaction, less scar tissue formation, it is less time consuming and provides better outcomes.

KEYWORDS

Fibrin glue, sutures, peripheral nerve, anastomosis

INTRODUCTION

Severe nerve injury has a devastating impact on patients' quality of life. Typical symptoms are sensory and motor function defects that can result in complete paralysis of the affected limb or development of intractable neuropathic pain. Nerve fibres of the transected nerve regenerate spontaneously to the extent limited by the size of the nerve gap, neuroma, and scar tissue formation[2]. Although considered a standard method in repairing peripheral nerve lesions, nylon thread suture may cause an inflammatory reaction that may affect the regeneration process and be difficult to perform in small-calibre nerves[3].

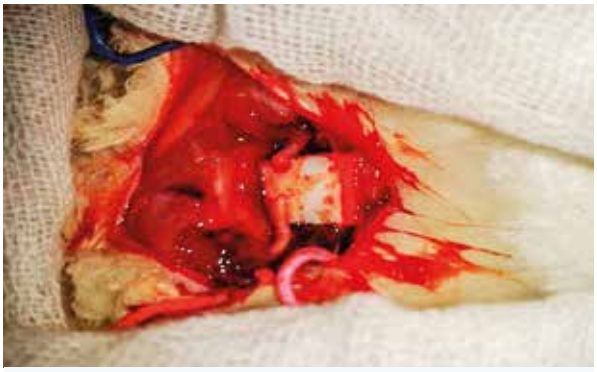


Fig.1. Exposed transected sciatic nerve

Fig. 2. Repair with a suture

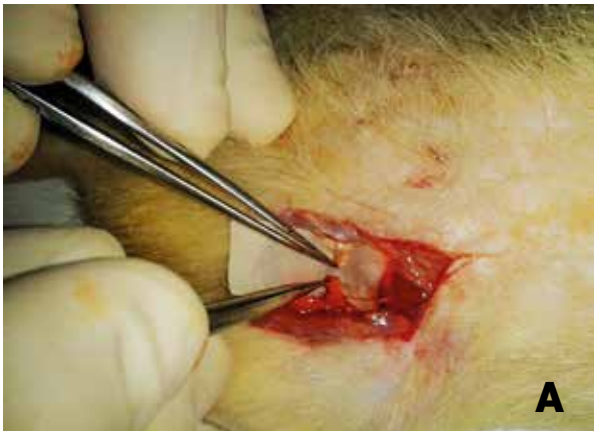
To improve the functional outcomes of peripheral nerve repair, a suture free seam with synthetic adhesive has been proposed as an alternative to micro-sutures for achieving proper coaptation of the nerve endings. Using fibrin glue in nerve repair in a rat model had provided better conditions for regeneration than suture after sciatic nerve transection in previous studies[4]. In our study, we are trying to extensively analyse the alternatives in many new aspects and after a longer postoperative period to have a wider scale of evaluation.

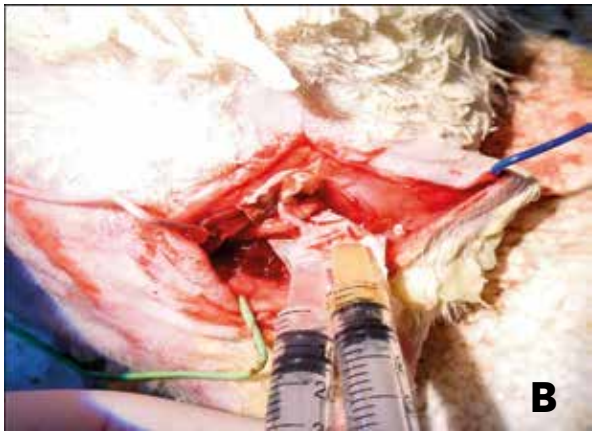
MATERIAL AND METHODS

This study was approved by the local ethical committee of Faculty of Medicine at Assiut University. A total of 70 Sprague Dawley rats were used for this study, weighing between 250 g and 300 g. The rats were divided into three groups. Group one consisted of 30 rats, in which the sciatic nerve was transected and immediately repaired with 10-0 suture (Daclon-SMI AG-Belgium). Group two consisted of 30 rats in which the sciatic nerves were transected and repaired by fibrin glue. Control group included 10 rats.

The rats were operated under general anaesthesia with intra-peritoneal Sodium Thiopental 500 mg (Farcopental-Pharco Pharmaceuticals-Egypt) in a dose of 0.03 mg–0.04 mg/g of body weight[5].

The dorsal aspect of both hind limbs to the midback was prepared by shaving and Betadine (Betadine–Nile Company–Egypt) washing. A dorso-lateral incision was made starting 0.5 cm laterally from the animal's midline and extending laterally for three cm towards the tibiofemoral articulation.





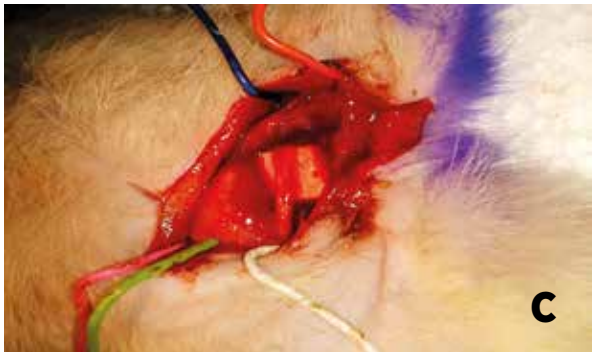


Fig. 3A. Holding the transected nerve ends from the epineurium and surrounding tissue

Fig. 3B. Fibrin glue application

Fig. 3C. Complete healing with fibrin glue

The femoral biceps and gluteus muscle were separated using blunt dissection to allow exposure of the sciatic nerve; transection was performed as shown in Figure 1.

In group one, cut ends of the nerve were repaired using the operating microscope (LEICA MS 5) with interrupted epineural micro-sutures using 10-0 monofilament polyamide spatulated suture as shown in Figure 2 with 220 µm diameter, 6.4 mm length, 3/8 circle needle (Daclon-SMI AG-Belgium).

In group two, the transected nerves were placed on a small piece of latex glove material and glued with fibrin glue, which was prepared at The Clinical Pathology Department of South Egypt Cancer Institute. It is mainly composed of Fibrinogen concentrate (vial 1); Thrombin containing 4.9 mg of dry thrombin was dissolved in 1 ml of calcium chloride solution (vial 2) as shown in Figure 3. It was applied as two drops of fibrinogen sealant solution followed by the thrombin solution over the aligned nerve stumps held with two Jweler forceps. Care was taken that a maximum contact area between nerve ends was obtained and the stumps were accurately coapted. Stabilization of the nerve ends was maintained for two minutes, the latex material was removed after five minutes. In the control group (10 cases) a piece of 15 mm of the sciatic nerve was carefully dissected and harvested without any further manipulations to be studied as a histological standard landmark in comparison to the other groups.

Animals were followed for up to 30 days. After the follow up period, gross appearance of nerves was observed for any dehiscence or neuroma formation. A 15 mm segment was excised including the anastomotic site and it was preserved in 10% formaldehyde solution and the specimens were processed for the following:

Histological evaluation

The specimens were fixed in 10% buffered formalin solution for 48 hours, and they were then dehydrated in ascending grades of ethanol and embedded in paraffin. Serial sections of 6–7 thickness were cut and subjected to Haematoxilin and Eosin stain for histological examination with light microscope. Masson Trichrome stain was also used to demonstrate extent of fibrosis.

Morphometric analysis

The studied groups were subjected to morphometric analysis using an image-analysing system software (Leica Q 500 MCO, Germany) at the Histology Department, Faculty of Medicine, Assiut University. Epineural thickness, cross-sectional diameter of the nerve and scar tissue formation index (epineural thickness dividing the whole cross sectional diameter) were measured[6]. The previously mentioned parameters were determined in H&E-stained sections at 40x magnification in ten non-overlapping fields of the entire section.

Statistical analysis

The anastomotic time (the time required to perform the anastomosis) was recorded in both techniques. Data were expressed as mean ±SD. Comparison between groups was done using Mann-Whitney test, using SPSS program version 19 (SPSS Inc., Chicago, Illinois, USA). P value less than 0.05 was considered significant.

RESULTS

In the first and second group, there was ulceration at the affected limb and adhesions with the surrounding muscles, which were nearly equal in both groups and were dissected carefully. There were no signs of infection or inflammation. There was one case of neuroma formation (localized swelling at the anastomotic site) in group one. In group two there was one case of partial wound dehiscence.

Histological evaluations

Nerve structure: In group one, nerve trunks were preserved but with marked axonal degeneration in the nerve fibres at and distal to the anastomotic site; there is also a marked increase in the number of leukocytes and other inflammatory cell infiltrate as shown in Figure 4A. In group two, examination revealed that the nerve trunks were preserved as a whole with smooth continuous more organized nerve fibres as compared with group one, but with smaller shrunken fascicle as shown in Figure 4B.

Degenerative changes: In group one, there was intensive endoneural hypercellularity with Schwann cell prolif-

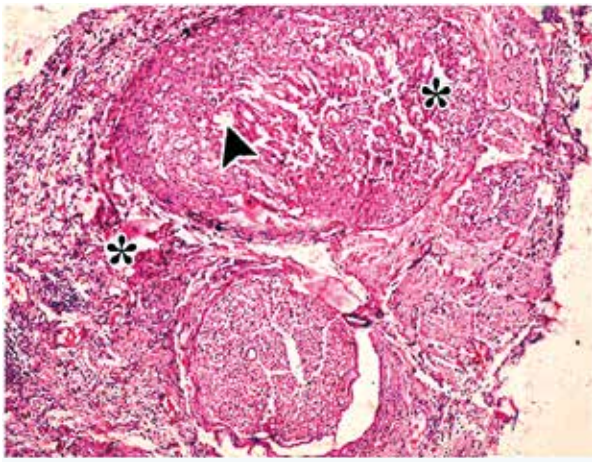


Fig. 4A. In group one the nerve structure as a hole was preserved but with axonal degeneration (arrow head) and inflammatory cell infiltration (*)

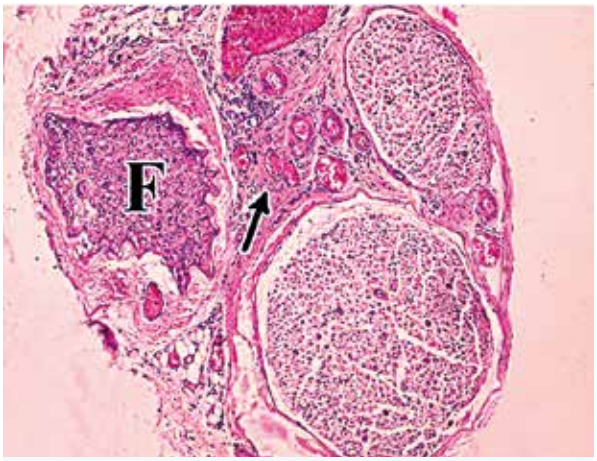


Fig. 4B. In group two there was increase of perineural blood vessels (arrow) and irregular shrunken blood vessels (F)

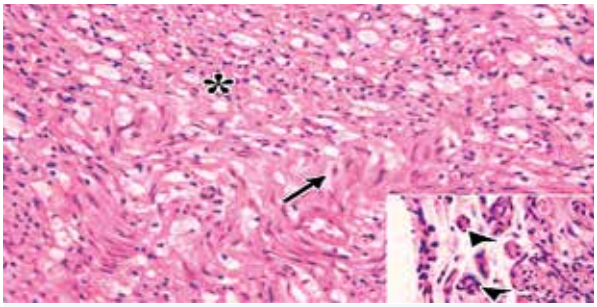


Fig. 5A. In group one with higher magnification there was intense endoneural hypercellularity (*), Schwann cell proliferation (↑) H&E X 400, and Multinucleated giant cell formation (arrow head). Inset X1000

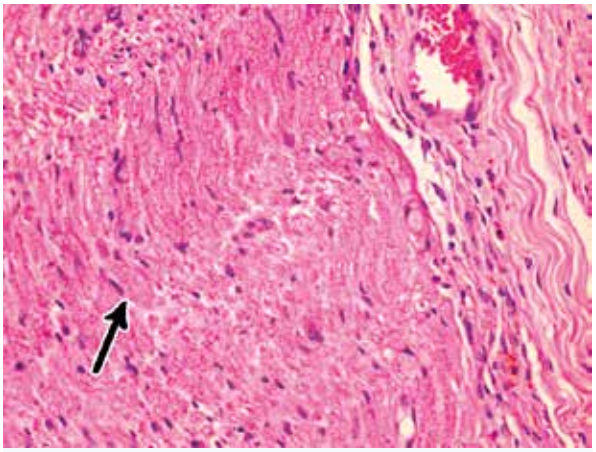


Fig. 5B. In group two a longitudinal section of sciatic nerve showed better nerve fibre organization and minimal Schwann cell proliferation compared with group one. H&E X400

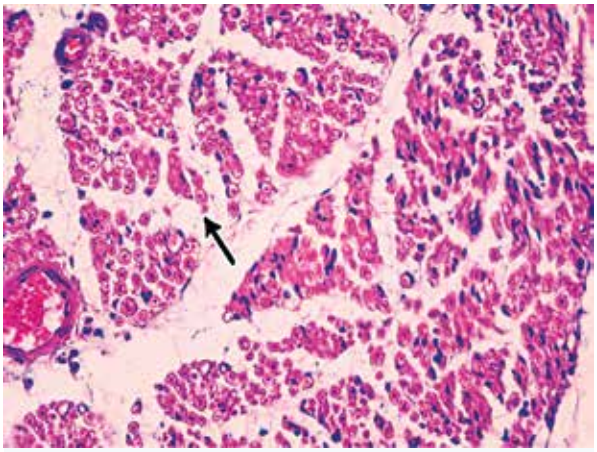


Fig. 5C. In group one there was also intense endoneural oedema H&E X 400

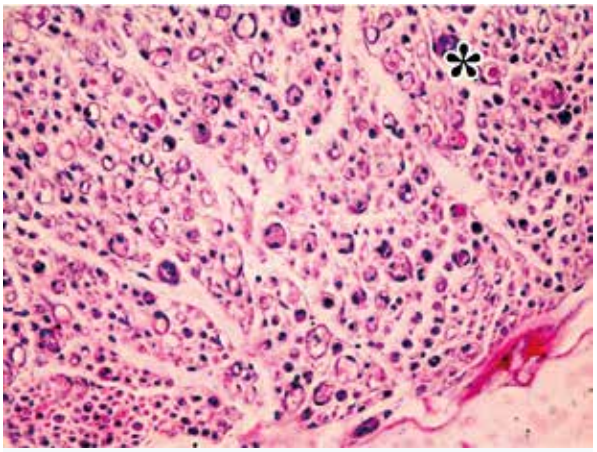


Fig. 5D. In group two a magnified transverse section of sciatic nerve showed decreased oedema and axonal degeneration compared with group one though inflammatory cell infiltration may still exist (*) H&E X400

eration and multinucleated giant cell formation as shown in Figure 5A. In group two, there was better nerve fibre organization and continuity with minimal Schwann cell proliferation as compared with group one as shown in Figure 5B. In group one, there was also marked endoneural oedema and marked axonal degeneration as shown in Figure 5C. In group two, a magnified transverse section of sciatic nerve in group two showing decreased oedema and axonal degeneration as compared with group one though inflammatory cell infiltration may still exist as shown in Figure 5D.

Blood vessels changes: In group one, there were apparently small calibre blood vessels compared to the control group as shown in Figure 6A, while in group two there were significantly remarkably dilated congested blood vessels with apparent increase in number compared with the group one as shown in Figure 6B.

Masson Trichrome stain (collagen deposition and fibrosis): In group one, there was marked increase in thickness (collagen deposition and fibrosis) of epineurium, perineurium and endoneurium as shown in Figure 7A. In group two, there was marked decrease of epineurial and perineurial thickness (fibrosis) compared with group one as shown in Figure 7B.

Morphometric and statistical analysis

Epineural thickness: Measurement of epineural thickness, which is an indicator of collagen deposition and fibrosis, showed that group one had the highest mean value with significant increase compared with control group and group two. Group two had also significant increase compared with the control, as shown in Figure 8.

Cross-sectional diameter: Group two had the highest value with significant increase compared with both group one and control group, as shown in Figure 9.

Scar tissue formation index: It is the ratio of epineural thickness divided by the whole cross sectional diameter of the nerve. There was significant decrease in group two compared with group one, as shown in Figure 10.

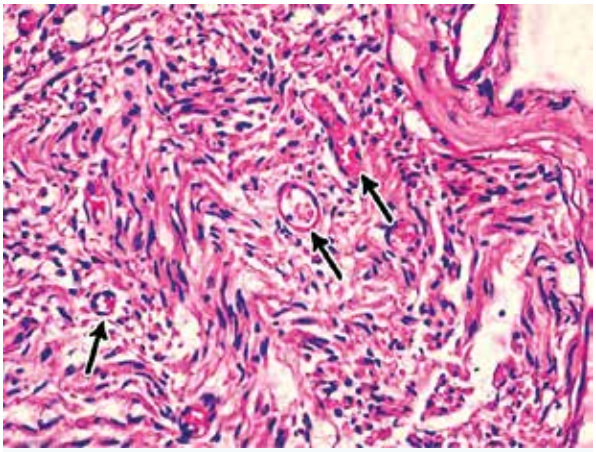


Fig. 6A. Smaller endoneural congested blood vessels (↑) H&E

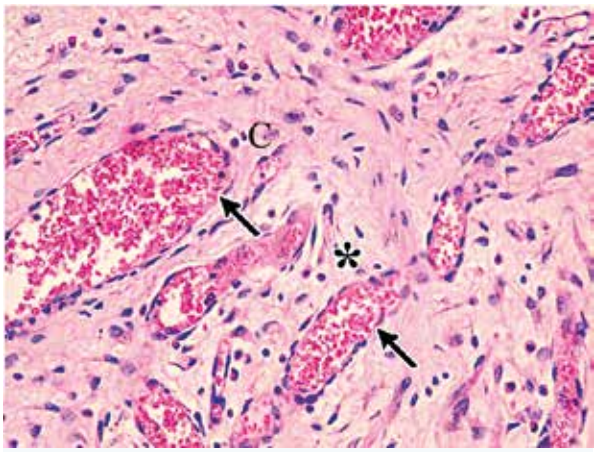


Fig. 6B. Multiple dilated congested blood vessels in the endoneurium (↑) surrounded by inflammatory cell infiltrate (*) H&E X400

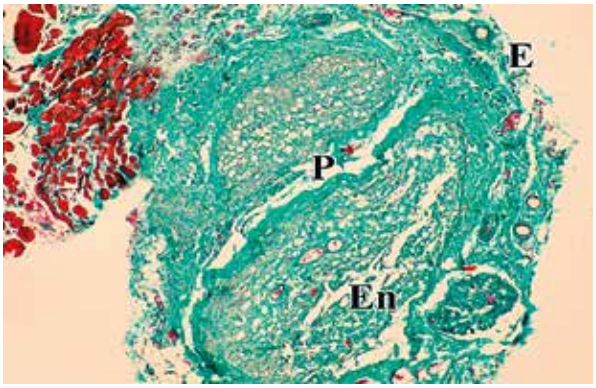


Fig. 7A. In group one there was marked increase in collagen deposition (fibrosis) in the epineurium (E), perineurium (P) and endoneurium (En)**.** Masson Trichrome X 100

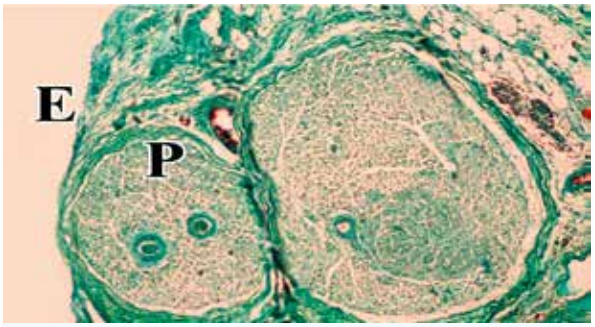


Fig. 7B. In group two there was marked decrease in epineural (E) and perineural fibrosis (P) compared with group one. Masson Trichrome X100

DISCUSSION

In 2005 Martins and his co-workers performed a similar study but with three groups; group one repair performed with suture only, group two repair performed with fibrin glue and group three repair performed with glue and suture. They showed that combination of the two factors had led to poorer regeneration of the nerve[7]. In our study we operated only on two groups in order to eliminate the factor of the suture and to identify the histological effect of each method alone.

Suture placement has been thought to cause hindrance to the sprouting axons and compression of the blood supply to the fascicles, thereby impairing the regeneration of the transected nerve ends after repair[8]. Moreover, formation of suture granuloma obstructs myelin and axonal regeneration. Many studies demonstrated inflammation and suture granuloma formation with subsequent neuroma formation after micro-suture repair, which results in focal hindrance to the regeneration of myelin and axons. In this work, we approved the previously mentioned changes but we demonstrated that there is no correlation between the number of sutures and the proper alignment of the nerve fascicles, as with two sutures only at 0 and 180 degrees, there were continuous nerve fibres and fascicles at histological examination. On the other hand, with three or four sutures, there was more tissue handling with subsequent more axonal degeneration.

Histological evaluation of our experiment showed a better outcome of axonal regeneration across the anastomotic site with fibrin glue repair in comparison with suture repair. Sciatic nerve after anastomosis by fibrin glue showed better nerve fibre organization and minimal Schwann cell proliferation compared with that repaired by sutures. Also, the perineural fibrosis, oedema and axonal degeneration in sciatic nerve repaired by fibrin glue were minimal compared with sciatic nerve repaired by suture. Multinucleated giant cells were seen in the suture group, which were not present in the fibrin glue group, which predisposes to neuroma formation. According to Anderson et al. in 2008, the foreign body giant cells (FBGC) are most commonly observed at the tissue/material interface of implanted medical devices, prostheses and biomaterials[9].

Moreover, the histological sections showed that the blood vessels in the fibrin glue group were significantly dilated and congested and increased in numbers compared to suture group where the blood vessels were apparently smaller

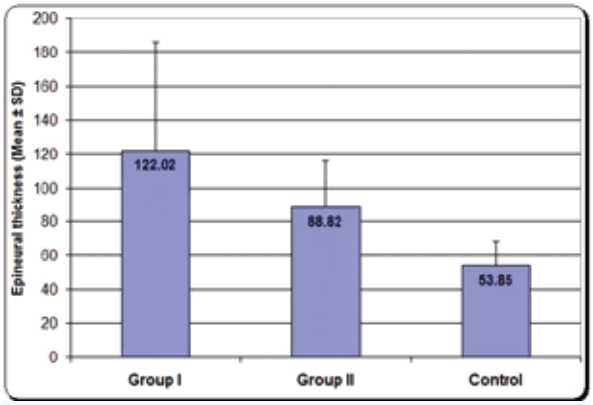


Fig. 8. Mean epineural thickness of group one, group two and control group

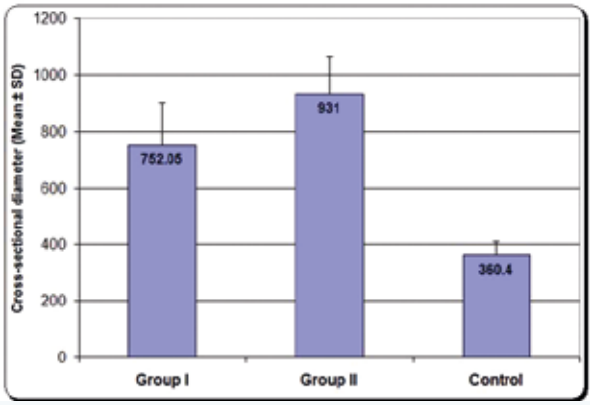


Fig. 9. Mean cross sectional diameter of group one, group two and control group

and less in number. This confirms the fact of compressing the blood vessels in anastomosis by micro-sutures, which lead to decreased blood supply to the fascicles. On the other hand, the fibrin glue causes significant capillary and endothelial proliferation at the fibrin glue-treated sites when compared with the controls, which is an important factor in rapid healing of the affected nerve. This was inconsistent with a study performed by Akosy et al., 2009[10].

In our work, we preferred to apply the fibrin glue in its concerned group of experiments without having any stay supporting stitches to have the best histological assessment and the evaluation of only one methodology used for each group. In addition to confirming the better quality technique for nerve repair by fibrin glue to replace suture technique, our goal was to prove the use of scar tissue formation index as early, simple quantitative measure for recovery of sciatic nerve after anastomosis. We found it easy and it does not require sophisticated methods. Scar tissue formation index is important for normal wound healing but in many clinical situations, scarring interferes with growth, causes deformities, and impairs normal function[11]. The current study revealed that there was significant decrease in the value of scar tissue formation index of sciatic nerve repaired by fibrin glue.

Operation time is one of the important factors in the choice of the surgical technique in nerve repair. Our results were in agreement with the conclusion of Breshah et al. in 2013[12], who reported that the application of both n-butyl-2-cyanoacrylate and fibrin glues was easier, simpler and less time consuming. Fibrin glue was superior to the n-butyl-2-cyanoacrylate both functionally and histologically and could be used as an alternative technique to epineural suturing in the microsurgical repair of the transected nerves. In our study the time required to complete nerve anastomosis with fibrin glue technique was significantly shorter than that with suture technique ($p<0.05$). With the use of fibrin glue, anastomosis time required was 1.85 ± 0.52 minutes. With suture technique, the time was 12.2 ± 2.85 minutes with gradual decrease in time required for anastomosis during the study.

The ideal surgical repair technique should accomplish good wound healing with minimal scar formation and direct the nerve sprouts into their correct targets. Although the scar formation with fibrin glue technique was less than

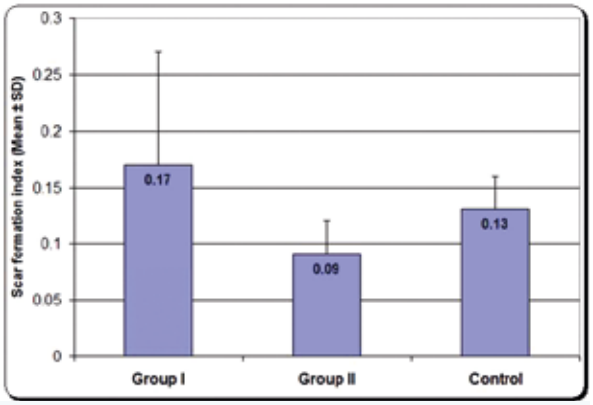


Fig. 10. Mean scar tissue formation index of group one, group two and control group

with suture technique, current surgical methods provide variable and often unsatisfactory outcomes. This may result in part because of our inability to stop the scaring process. The development of new therapeutic agents that can reduce scar formation may be the ultimate solution to this problem.

We recommend trying to use fibrin glue in controlled human studies in patients with peripheral nerve injuries. It is possible to expect promising results, similarly as in our study, mainly lower inflammatory reaction, less scaring, shorter time needed for treatment and generally better outcomes.

CONCLUSION

In microsurgical nerve repair suture placement has been thought to cause hindrance to the sprouting axons and compress the blood supply to the fascicles, thereby impairing the regeneration of the transected nerve ends after repair. Moreover, there is a possibility of formation of suture granuloma that obstructs myelin and axonal regeneration. Nerve anastomosis by fibrin glue is a simple, effective technique, which is less time consuming than suturing. Another advantage of this suture-free technique is that it avoids injuring the axon with needles, and the lack of foreign bodies minimizes the inflammatory reaction.

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INTRAOPERATIVE FAT GRAFTING INTO THE PECTORALIS AND LATISSIMUS DORSI MUSCLES – NOVEL MODIFICATION OF AUTOLOGOUS BREAST RECONSTRUCTION WITH EXTENDED LATISSIMUS DORSI FLAP

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ABSTRACT

Background: The latissimus dorsi flap is a reliable and one of the most commonly used methods of both immediate and delayed breast reconstruction. Its disadvantage is the limited volume of transferred tissue. The authors present their experience with the use of extended latissimus dorsi flap associated with immediate fat grafting into the pectoralis and latissimus dorsi muscles for secondary breast reconstruction.
Methods: From 2013 to 2016, 14 patients underwent secondary unilateral total breast reconstruction with extended latissimus dorsi flap associated with primary fat grafting into the pectoralis major and latissimus dorsi muscles. Fat was injected under visual control between muscle fibers. Fat injected into the pectoralis muscle formed an apparent bulging - autoprosthesis.
Results: Mean patient age was 48.2 years (range, 34 to 64 years). Mean injected fat volume was 86.4 ml (range, 50 to 160 ml) and majority of this volume was injected into the pectoralis muscle. All flaps healed uneventfully and no fat grafting-related complications were observed. The most common complication was donor site seroma, which occurred in 57.1%. Results of postoperative ultrasound examination were evaluated. Incidence and the size of oil cysts and fat necroses were significantly lower in muscular layer in comparison with the subcutaneous layer of the reconstructed breast.
Conclusions: Immediate fat transfer into the pectoralis and latissimus dorsi muscle increases the breast volume during the reconstruction with extended latissimus dorsi flap avoiding implant-related complications when abdominal tissue is not available. Pectoralis and latissimus dorsi muscles were shown as reliable and safe recipients for fat grafting.

KEYWORDS

Latissimus dorsi, breast reconstruction, autologous, secondary, fat grafting, pectoral muscle

INTRODUCTION

The latissimus dorsi flap is a reliable and one of the most commonly used methods of both immediate and delayed breast reconstruction. Latissimus dorsi flap reconstruction was introduced first by Tansini in 1906 [1] and popularized by Olivari and Schneider in the late 1970s [2,3]. Its use is traditionally limited by the volume of transferred tissue and by the desired size of the breast. The volume of the breast is therefore routinely created by silicone prosthesis in one stage as described by Bostwick and colleagues [4,5]. In this concept, the disadvantages associated with the use of

Patient	Age [years]	BMI [kg/m²]	RT	AAF		Injected fat volume [ml]			Additional lipomodelling sessions		
									Number of sessions	Injected fat volume [ml]	
					Follow-up [months]	total	PM	LTD		1st session	2nd session
1	44	21.1	yes	no	34	50	30	20	2	228	72
2	50	28.7	no	no	29	50	50	0	1	190	
3	53	23.4	yes	yes	25	50	50	0	1	255	
4	41	20.4	yes	yes	25	60	30	30	2	200	165
5	53	20.6	no	no	25	80	80	0	1	140	
6	43	24.2	yes	yes	22	90	40	50	2	205	130
7	59	21.9	yes	no	22	60	30	30	1	135	
8	63	27.5	no	no	15	80	40	40	2	130	225
9	44	37.6	no	no	11	160	110	50	0		
10	34	24.9	yes	yes	9	120	60	60	1	150	
11	35	23.7	no	yes	8	155	120	35	0		
12	52	20.8	yes	yes	5	40	40	0	1	110	
13	64	26.6	no	yes	4	130	100	30	0		
14	40	23.5	yes	no	3	80	30	55	1	210	
Median	**47.0**	**23.6**			**18.5**	**80.0**	**45.0**	**30.0**	**1.0**		
Mean	**48.2**	**24.6**	**8 of 14**	**7 of 14**	**16.9**	**86.4**	**57.9**	**28.6**	**1.0**		

Table 1. Patients and operative data. RT: adjuvant radiotherapy after mastectomy, AAF: abdominal advancement flap, PM: pectoralis muscle, LTD: latissimus dorsi muscle. No adipose tissue was applied into the latissimus dorsi muscle in the cases when it was too thin (patients No. 2, 3, 5, 12). And also no fat graft was applied into the pectoralis muscle in one patient with the history of implant based breast reconstruction with atrophic pectoralis muscle (patients No. 12)

the latissimus dorsi flap (donor site morbidity) and disadvantages of silicon implant (risks of infection, extrusion, rupture, capsular contracture and a recently suggested association with anaplastic large-cell lymphoma) occur both together.

The need for an implant may be avoided if the latissimus dorsi flap is harvested as extended when the whole muscle is taken. Hokin in 1983 and Marshall in 1984 increased the volume of the latissimus dorsi flap as they included lumbar fascia [6,7]. Germann in 1996 [8] and Delay in 1998 [9] introduced the technique of latissimus dorsi flap harvesting when the supplementary volume of the flap was increased by the subfascial fat localized in scapular and parascapular region, in addition to the lumbar fat. Delay also defined individual fatty zones adjacent to the latissimus dorsi muscle anatomically and he popularized this reconstructive approach [10]. In addition, Delay improved the options for autologous breast reconstruction by combining extended latissimus dorsi flap with abdominal advancement flap allowing breast reconstruction with one final horizontal scar [11].

Because of low morbidity, low complication rate, very good results and an excellent acceptance by the patients, autologous fat grafting has recently become recognized as an essential tool in breast reconstructive surgery. Sinna and colleagues demonstrated in consecutive sample of 200 patients that lipomodelling improves outcomes after extended latissimus dorsi flap reconstructions by augmenting breast volume and by enhancing its shape [12–14]. Finally, Santanelli and colleagues have recently reported their technique of latissimus dorsi flap reconstruction associated with intraoperative fat grafting to the subcutaneous tissue of the latissimus dorsi flap as an alternative for entirely autologous breast reconstruction [15].

The aim of this study is to present a new concept of autologous breast reconstruction with the extended latissimus dorsi flap associated with simultaneous fat grafting into the pectoralis and latissimus dorsi muscles.

PATIENTS AND METHODS

Between April 2013 and February 2016, 14 patients underwent secondary unilateral total breast reconstruction with extended latissimus dorsi flap associated with primary fat grafting into the pectoralis major and latissimus dorsi muscles (Table 1). This surgical technique was indicated for patients after mastectomy requiring breast reconstruction desiring small or moderate breast volume, patients who refused scars on the abdomen or patients with the contraindication for abdominal free flap such as: 1) multiple abdominal scars, 2) previously harvested abdominal flap or abdominoplasty, 3) patients with a history of deep venous thrombosis or pulmonary embolism (Table 2).

Choice of autologous latissimus reconstruction over abdominal flap in 14 patients	Incidence	Percent [%]
Slim patient with a relatively small excess of abdominal skin	7	50.0
Non-acceptance of abdominal scars	4	28.6
Age > 60 yr	2	14.3
Smoking	2	14.3
History of previous breast reconstruction using abdominal flap	2	14.3
Concerns about the surgery with a potential risk of flap loss	1	7.1
History of deep vein thrombosis or pulmonary embolism, or factor V Leiden mutation	0	0.0

Table 2. Choice of autologous latissimus reconstruction over abdominal flap

Preoperative design

Planning begins in the chest in the front view. The median intermammary line, the inframammary crease and the foreseeable extent of the breast is designed in the post-mastectomy chest using opposite breast as a model. In the case of serious hypertrophy or ptosis of the preserved breast, patients are informed about the need of contralateral symmetrization in the second stage to obtain appropriate results. In cases with sufficient laxity of the skin below the submammary fold, the abdominal advancement flap may be conveniently used to reconstruct the skin of the lower part of the breast – this maneuver allows to reduce the minimum size of latissimus dorsi flap skin paddle and to reduce the length of the scar on the back respectively.

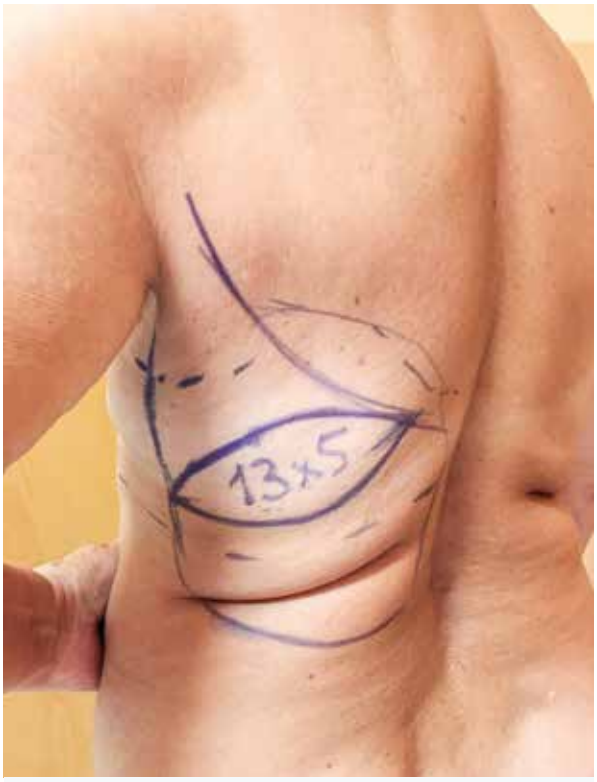

Fig. 1. Latissimus dorsi flap planning. The bra strap area is marked first when the patient is wearing her bra. The horizontal or slightly transverse skin paddle is localized in the middle of the bra strap area

The bra strap area is then marked on the patient's back in the upright position. The horizontal or slightly oblique skin paddle is drawn on the middle of the bra strap area (Fig. 1), the pinch technique is used to determinate its maximum width. In the case, when the abdominal advancement flap is planned simultaneously, we minimize the size of the skin paddle (6 x 14 cm approximately). In other cases, the size of the skin paddle is outlined with respect of the extent of the missing skin on the breast.

Donor site for fat harvesting is marked according to the patient's wish and expected volume of fat graft (100–150 ml of processed adipose tissue should be prepared). Lower abdomen and inner thighs are preferred harvesting sites because of easy positioning of the patient in the supine position. We do not recommend fat harvesting from the flanks because of the risk of blood supply deterioration of the elevated skin after latissimus dorsi flap harvesting due to instillation of tumescent solution (with epinephrine) and liposuction in closely surrounding area.

Surgical technique

Latissimus dorsi flap harvesting was performed simultaneously with subcutaneous undermining of the anterior thorax in lateral decubis position. We used modification of harvesting technique described by Delay [10]. The volume of the latissimus dorsi flap was extended by harvesting: 1) adipose tissue of the paddle below the superficial fascia retained on the entire surface of the muscle, 2) the scapular fat pad, 3) the fat adjacent to the anterior part of the muscle. On the contrary, we did not harvest supra-iliac fat pad.

Once the flap was raised and the pedicle clearly visible and free, a subtotal section of the muscle was performed distally and just a small muscular bridge was left to protect the vascular pedicle. The thoracodorsal nerve was preserved. The completely raised flap was then passed underneath the skin bridge anteriorly into the dissected subcutaneous pocket on the chest. The donor site was closed primarily.

Then, the patient was turned to the supine position and subcutaneous undermining of the anterior thorax was finalized. The abdominal advancement flap was dissected and a new inframammary fold was created in the patients who were scheduled for it.

Adipose tissue was harvested preferably from the lower abdomen or inner thighs region. Low-volume tumescent liposuction was used (500 ml of normal saline with 1:500 000 of epinephrine). Adipose tissue was aspirated manually into 30-ml Luer-lock syringes using 3.5 mm cannula (model PLA187, Pouret Medical, France) and it was centrifuged at 1200 g for 3 minutes directly in 30ml syringes.

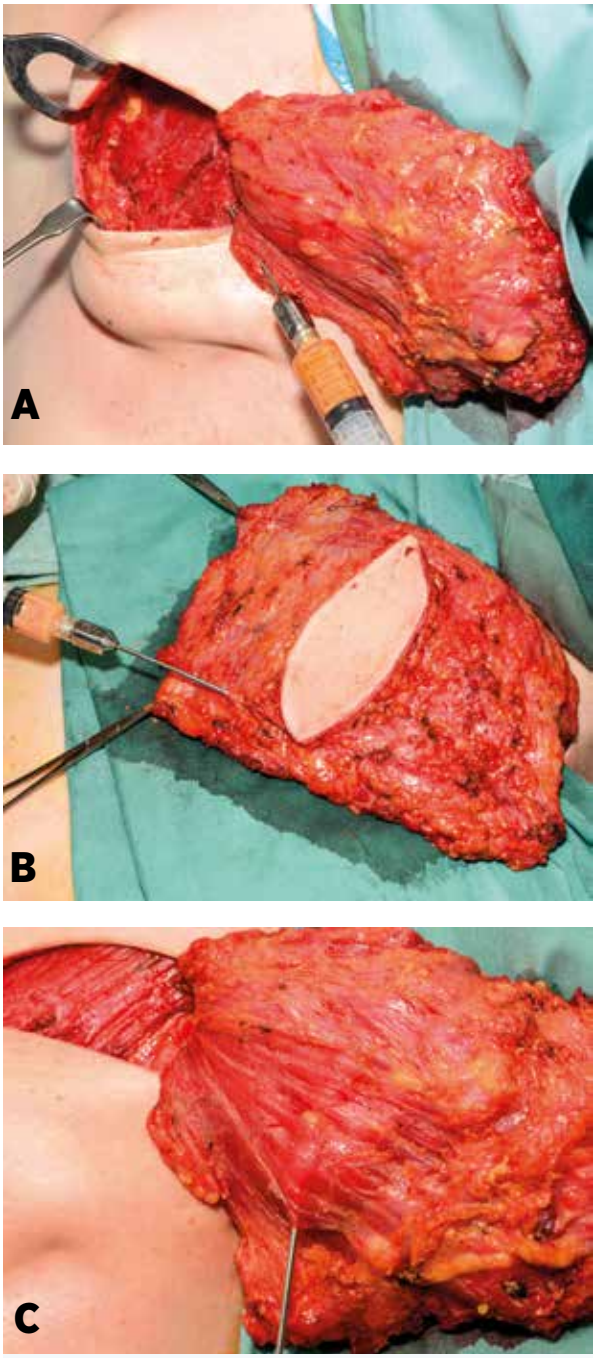

Fig. 2. Application of the processed fat (a) into the pectoralis muscle and (b, c) into the latissimus dorsi muscle

Processed fat was injected first into the pectoralis muscle from several points (4–6 points) longitudinally and transversely relative to the orientation of muscle fibers with 10 ml syringes using 2 mm cannulas (model PLA189, Pouret Medical, France). In this way, the fat was applied first into the deep layer, then into the middle layer and finally into the superficial layer of the muscle. Because the cannula and the injected fat are visible between the muscle fibers (during application into the middle and superficial layers) the fat transfer can be done accurately under visual control till the formation of a small bulging – autoprosthesis. Fat was analogically injected between superficial muscle fibers and also into the adipose layer of the skin paddle of the latissimus dorsi flap (Fig. 2). After fat injection, the latissimus dorsi flap was secured to the breast pocket so that the originally distal part of the flap created volume of the décolleté area. The latissimus dorsi flap was then folded in the bottom part of newly reconstructed breast to form extra bulk. Breast skin was finally draped over the new mound and the latissimus dorsi skin paddle was partially or totally de-epithelialized. Two suction drains were positioned before skin closure.

One or two sessions of lipomodelling were performed secondary at least 3 months after the previous surgery under general anesthesia. Contralateral symmetrizing mastopexy or reduction mammoplasty was performed 3-6 months after breast reconstruction, and finally in the following 3 months, nipple reconstruction using local flaps and areolar reconstruction using tattooing were performed under local anesthesia, if required by the patient.

Follow-up

All the patients were examined 1) clinically 2 weeks postoperatively, 2) clinically and by ultrasound shortly before each additional session of lipomodelling (when performed) and finally 3) clinically and by ultrasound at least 3 months postoperatively (after latissimus dorsi breast reconstruction or after final session of lipomodelling). The size and the number of fat necroses were evaluated by ultrasonography by a single experienced radiologist. Photographs were taken during each follow-up visit.

RESULTS

Breast reconstruction using the extended latissimus dorsi flap associated with fat grafting was performed in 14 patients. The mean patient age was 48.2 years (range, 34 to 64 years). The mean body mass index was 24.6 kg/m^2 (range, 20.4 to 37.6 kg/m^2) and 8 of these 14 patients had a history of adjuvant radiotherapy. In 7 patients, abdominal advancement flap was used to reconstruct the lower pole of the breast. Patient and operative data are shown in Table 1. The mean injected fat volume was 86.4 ml (range, 50 to 160 ml) when majority of volume was injected into the pectoralis major muscle. The mean injected fat volume to the pectoralis muscle was 57.9 ml.

Incidence of complications in 14 patients	Incidence	Percent [%]
Partial flap loss	0	0.0
Total flap loss	0	0.0
Partial breast skin flap loss	0	0.0
Partial dorsal skin flap loss	0	0.0
Wound infection	0	0.0
Hematoma	2	14.3
Seroma	8	57.1

Table 3. Complications

	Thickness of the layers of the reconstructed breast (maximum values)				Number and size of fat necrosis or oil liponecrotic pseudocysts	
Patient	**Overall thickness**	**Muscular layer (PM+LTD)**	**Subcutaneous layer**	**% of muscular layer**	**Muscular layer**	**Subcutaneous layer**
2	24	19	12	79.2	S	M
3	47	32	14	68.1	-	SS
4	34	20	17	58.8	-	S
5	50	27	23	54.0	S	SSS
6	31	22	14	71.0	-	S
8	44	39	16	88.6	-	SSS
9	38	19	15	50.0	-	-
11	43	25	18	58.1	-	SS
12	25	15	12	60.0	-	-
13	44	34	10	77.3	-	-
Median				**64.0**		
Mean				**66.5**		

Table 4. Evaluation of the postoperative breast ultrasound examination. The size of fat necrosis or oil liponecrotic pseudocysts is expressed by different letters: S – small (up to 10 mm in diameter), M – medium (10 to 20 mm in diameter) and L – large (more than 20 mm in diameter). The number of these fat necroses or oil liponecrotic pseudocysts is expressed by the number of these letters: one letter = single, two letters = sporadic (2–10), three letters = frequent (more than 10) and finally hyphen = none

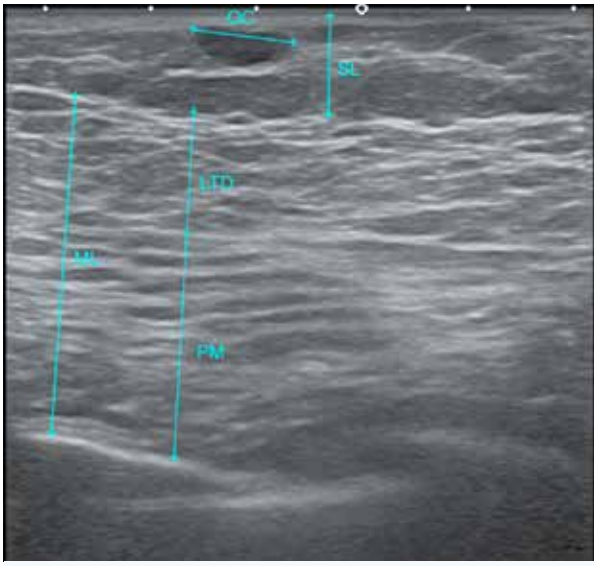

Fig. 3. Typical postoperative ultrasound image. Muscular layer (ML) after fat grafting is shown as a homogeneous structure with significant lipomatous changes without oil cysts or fat necroses. The pectoralis (PM) and the latissimus dorsi (LTD) muscles can be distinguished according to the orientation of muscle fibers. There are single medium size oil cysts (OC) in the subcutaneous layer (SL)

Suction drains were removed at around 6th postoperative day (range, 5th to 8th) when the fluid drainage from individual drain was less than 20 ml per 24 hours and when the patients were discharged from the hospital. The most common complication was seroma in the donor site (57.1%) and the most serious complication was dorsal hematoma with the need of early surgical revision. No fat grafting related complications were observed in either the recipient or the donor site (Table 3).

Eleven patients required an additional session of lipomodelling to enhance final breast volume and to improve breast shape while two sessions were need in 4 patients to obtain desired results. Then, 3 patients required symmetrizing surgery because of contralateral breast ptosis (2 patients) or relative hypertrophy (1 patient). Vertical scar mastopexy or wise pattern reduction mammoplasty was performed in these cases 3–6 months after breast reconstruction.

Postoperative ultrasound images were acquired for 10 patients. Specifically, number and size of oil cysts (oil liponecrotic pseudosysts) and fat necroses were evaluated separately for muscular layer (composed of pectoralis and latissimus dorsi muscles) and for subcutaneous layer of the reconstructed breast. We also evaluated maximal thickness of these layers and also overall maximal thickness of the reconstructed breast (Fig. 3, Table 4). Incidence and the size of oil cysts and fat necroses were significantly lower in muscular layer as compared with the subcutaneous layer. The muscular layer after fat grafting appeared as a homogeneous structure with significant lipomatous changes in comparison with normal skeletal muscle. The thickness of the muscular layer was expanded in additional stages of fat grafting. The resulting breast volume was made up mostly of the muscular layer augmented by fat grafting.

Preoperative and postoperative photographs are shown (Figs 4, 5). Satisfactory results were obtained and the scars in the donor area were well hidden under the bra strap and no contour defects were observed.

DISCUSSION

The breast reconstruction after mastectomy represents an integral component of the complex oncological care of

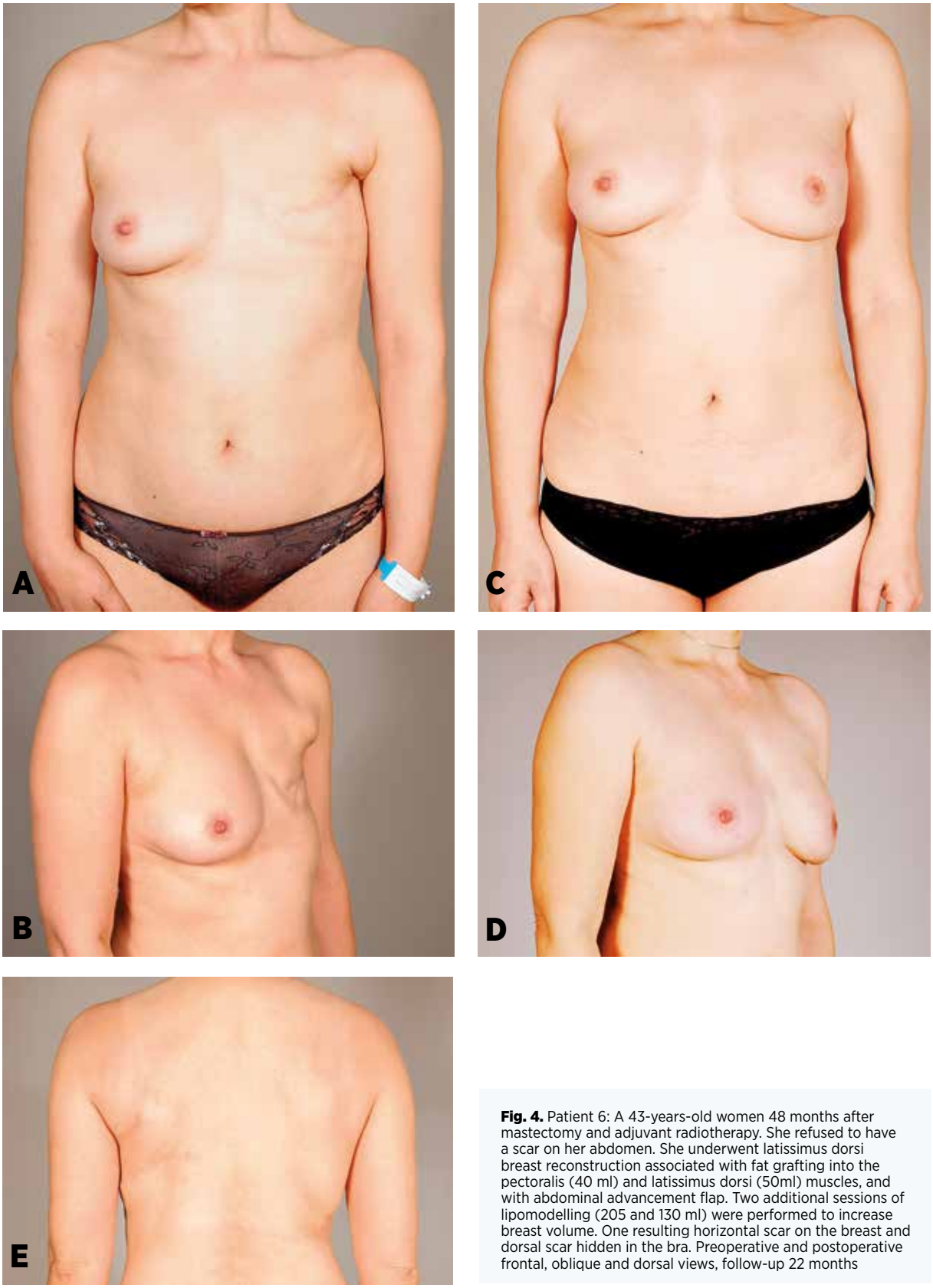

Fig. 4. Patient 6: A 43-years-old women 48 months after mastectomy and adjuvant radiotherapy. She refused to have a scar on her abdomen. She underwent latissimus dorsi breast reconstruction associated with fat grafting into the pectoralis (40 ml) and latissimus dorsi (50ml) muscles, and with abdominal advancement flap. Two additional sessions of lipomodelling (205 and 130 ml) were performed to increase breast volume. One resulting horizontal scar on the breast and dorsal scar hidden in the bra. Preoperative and postoperative frontal, oblique and dorsal views, follow-up 22 months

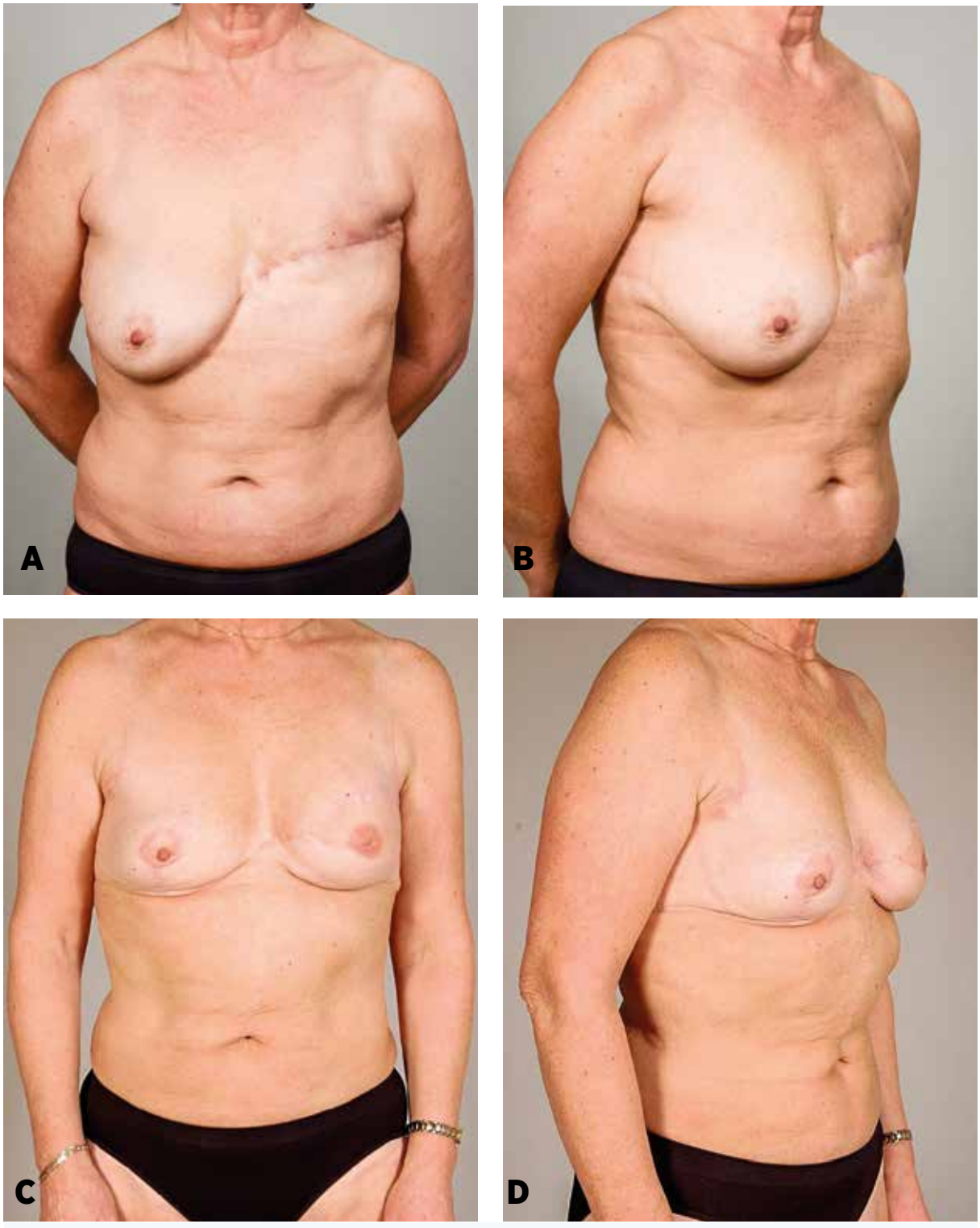

Fig. 5. Patient 3: A 53-years-old women 18 mounts after mastectomy and adjuvant radiotherapy. She was not considered a good candidate for a DIEP flap breast reconstruction because she was very thin and a strong smoker. She underwent latissimus dorsi breast reconstruction associated with fat grafting into the pectoralis muscle (50 ml), and with abdominal advancement flap (allowing to reduce the size of the skin paddle and thus the length of the scars on her back). One additional session of lipomodelling (255 ml) was performed to increase breast volume. Preoperative and postoperative frontal and oblique views, follow-up 25 months

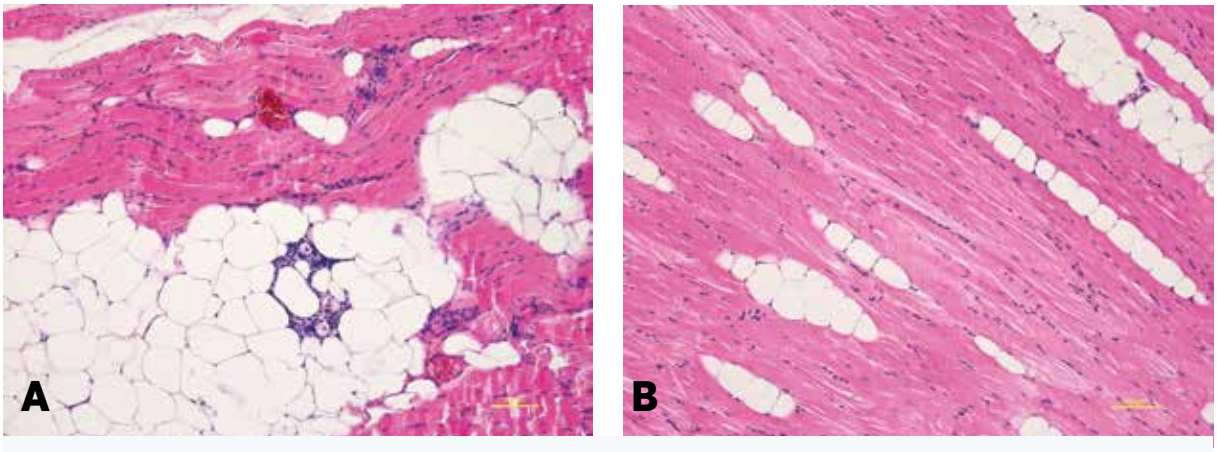

Fig. 6. Histological examination of the muscles: (a) the pectoralis muscle after fat grafting with lipomatous changes, (b) the serratus anterior muscle - the control sample from the same patient (without fat grafting). Haematoxylin eosin staining. Scale bar 100 μm.

breast cancer patients restoring physical and psychological integrity and improving women's quality of life [16]. Choice of reconstructive technique is a multifactorial decision based on several factors including patients' age, body type, comorbidities, history of adjuvant radiotherapy and the size of contralateral breast. This decision is considerably influenced by the surgeons' preference and experience. Implant based breast reconstruction is generally associated with lower invasiveness in the sense of donor site morbidity. In spite of that, autologous techniques are often preferred for the disadvantages of using silicone implants (risks of infection, extrusion, rupture, capsular contracture and a recently suggested association with anaplastic large-cell lymphoma [17]). The abdominal free flaps and the latissimus dorsi flap are two most common autologous techniques today. The abdominal free flaps are often considered to be the gold standards for autologous breast reconstruction. In our department, we perform approximately 130 abdominal free flap breast reconstructions per year representing approximately 80% of autologous reconstructions [18–20].

We believe that current approaches to breast reconstruction based on the latissimus dorsi flap represent valuable alternatives for the patients who are not good candidates for abdominal based flaps, or even primary option for the patients who refuse to have a scar on the abdomen, or do not wish to undergo more demanding microsurgical procedures with the risk of flap loss. We also suggest the latissimus dorsi flap as a preferable alternative to the abdominal free flaps in patients with small skin excess in the lower abdomen when the resulting scar is usually pushed upwards above the edge of the underwear. In our department, latissimus dorsi breast flap represents approximately 10% of all performed autologous breast reconstructions.

Lindegren and the colleagues compared DIEP and latissimus dorsi flaps breast reconstruction with regards to the satisfaction with the aesthetic outcomes between the patients and plastic surgeons. The patients were more satisfied with latissimus dorsi flap reconstruction, which was related probably to the donor-site scar. Surgeons favored DIEP flap reconstruction with regards to the size and shape of the breast [21].

Santanelli and colleagues have recently reported their technique of latissimus dorsi flap volume expansion with intraoperative fat grafting to the subcutaneous tissue of the skin paddle of the latissimus dorsi flap as an alternative for entirely autologous breast reconstruction. In their study, the mean size of the harvested skin paddle was 19.7 x 11.0 cm and the mean injected fat volume was 101 ml [15].

We believe that too extensive harvest of skin paddle may result in more obvious disfigurement in the donor site area. Therefore, we have made an effort to minimize this disfigurement and the size of the scar on the back; the size of the skin paddle was up to 6 x 14 cm in the majority of the patients. Instead, we supplemented latissimus dorsi flap volume by adipose tissue from the areas where reduction of volume was beneficial. Furthermore, we injected fat into the pectoralis muscle. During our initial experiences, quantities of transferred adipose tissue were small, but we have gradually increased these quantities to 60 ml injected into the latissimus dorsi and to 120 ml injected into pectoralis muscles (see Table 1). We demonstrated that the capacity of pectoralis muscle to accept volume of the fat graft is about 2 times higher. We believe that this capacity is related to the initial thickness of the muscle layer while the pectoralis muscle is noticeably thicker than the latissimus muscle.

Ultrasound did not reveal higher incidence of fat necrosis in the muscular layer associated with the increasing volumes of the fat graft. Furthermore, number of fat necroses (cystoids) was significantly lower in muscular layer comparing with subcutaneous layer (Figure 3, see Table 4). These findings indicate that skeletal muscle is suitable and well-vascularized recipient tissue. Since the pectoralis muscle is exposed during breast reconstruction, fat graft can be applied under visual control, which enables application of fat more evenly in layers and thus to transfer higher volumes of adipose tissue. Analogically, fat graft is injected under visual control during immediate breast reconstruction by fat grafting [22–24], or without visual control during the secondary reconstructions [24,25].

Skeletal muscle seems to be eligible recipient tissue for adipose tissue grafting because it contains natural adipocytes [26]. We had the opportunity to observe the pectoralis muscle in the 49-years-old patient 6 months after application of fat when we narrowed the breast base secondary after secondary breast reconstruction with lipomodelling (patient had

skin excesses laterally because she had suffered from breast hypertrophy before mastectomy). After obtaining informed consents, we took small skeletal muscle samples (approximately 1 x 1 x 2 cm) from the pectoralis muscle after fat grafting and from the serratus anterior muscle (without fat grafting). Macroscopically, we observed lipomatous changes of the pectoralis muscle. Subsequently, the samples of the muscle were processed with the standard formalin – paraffin technique. 4 µm thick sections were cut with microtome, routinely stained with haematoxylin and eosin, and evaluated under the light microscope. In both samples, muscular component was well preserved. But we observed significantly higher number of adipocytes (respectively areas of adipose tissue) between muscle fibers in the sample taken form the pectoralis muscle after fat grafting. In the muscle sample of serratus anterior muscle from the same patient, we detected only a small number of adipocytes (Fig. 6).

Adipocytes are found in the skeletal muscle naturally and fat content within muscles increases with age and atrophy and finally in paresis [27]. Therefore, it is possible to understand the fat transfer into the muscle as an enlargement of its "adipose component" rather than as an application of tissue that in general does not belong to the skeletal muscle.

Capacity of the donor site to accept the fat graft is closely related to the initial volume of well-vascularized donor tissues. We believe that the degree of volume absorption is low when the transferred fat is covered by well-vascularized tissue like skeletal muscle. Based on our experiences we estimate the absorption about 30% in this case.

We can imagine a further increase in the quantity of the transferred fat up to the maximum of 140–160 ml into the pectoralis muscle and 60–70 ml into the latissimus dorsi muscle in normal-weight or slightly overweight patients. But we assume that the risk of complications associated with poor engraftment of the fat could increase beyond an acceptable level when transferred quantities were even higher. According to our experience, the best results are obtained in patients with BMI 20–26. Very thin patients usually have thinner recipient muscles. Furthermore, these very thin patients may not have enough adipose tissue in the donor sites.

The lack of a control group is the weakness of our study. Further prospective controlled clinical trials are needed to confirm our findings.

CONCLUSIONS

Our new modification of breast reconstruction with extended latissimus dorsi flap with immediate fat grafting into the pectoralis and latissimus dorsi muscles is a safe and reliable method for entirely autologous secondary breast reconstruction. Pectoralis and latissimus dorsi muscles were shown to be reliable and safe recipients for grafted fat. Fat grafting into the pectoralis and latissimus dorsi muscles during extended latissimus dorsi flap reconstruction allows reconstructing additional breast volume. We believe that our new concept may potentially reduce the number of required additional lipomodelling sessions, which often follow latissimus dorsi breast reconstruction.

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HAS A GLOMUS TUMOR ALWAYS A QUICK DIAGNOSIS?

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ABSTRACT

Introduction: Glomus tumor is a rare and benign vascular tumor. Although symptoms specific for this tumor are quite clear, there is still a delay between the onset of symptoms, diagnosis and subsequent surgical therapy. The authors monitor the time from the onset of symptoms to the diagnosis and management of the problems.
Material and Methods: Between 2004–2012, a total of 5 patients were diagnosed with subungual glomus tumor in the area of the distal phalanges of the hand. It involved 3 women and 2 men with the mean age of 32.2 years (26–47 years). During the first examination, we monitored the duration of symptoms, number and specialty of the doctors who examined the patient, and what examinations were performed. When the cold test was positive, MRI was performed and the patients were indicated for surgical revision. Tissue samples in all patients were histologically examined. Patients were followed for 2 years.
Results: It was found that the patients had clinical symptoms for an average of 2.4 years. In our group, the patients were examined by an average of 5.4 physicians (3–9 physicians). On examination before surgery, three patients reported changes in the nail bed and two patients reported no change. When following the patients 2 years after the surgery, relapse occurred in one patient and it was treated with reoperation. During regular follow-up 2 years after the surgery, 4 patients were without nail deformity. In one patient, there was resulting nail deformity. Relapse occurred in only one case.
Discussion: Because the glomus tumor is a rare lesion, occurring most frequently in the nail bed, early diagnosis is still a problem. Even in literature, we encounter a similar time frame from the onset of symptoms until the final diagnosis of 1.9 to 8 years.
Conclusion: Although clinical signs and problems concerning the glomus tumor are very obvious, there still remains a long time for diagnosis. It would certainly be most beneficial for patients with persistent symptoms not to be referred to different specialists, but directly to a department that specializes in hand surgery.

KEYWORDS

Glomus tumor, tumor of the hand, hand tumor, diagnosis

INTRODUCTION

A glomus tumour is a rare and benign vascular tumour. The normal glomus is a neuromyoarterial body. It was first described in 1821 by Wood, but histologically was glomus tumor described in 1924 by Masson.[1] It occurs mostly under the fingernails and very rarely in other locations. They constitute less than 2% of soft tissue tumors of the hand (0.2% of soft tissue tumors of the human body).[2] Quite exceptionally, the glomus tumor can present in multiple forms. Clinically it manifests as a reaction to cold with sharp resting pain, which increases during nail palpation or when the locus is tapped.

During an examination, the glomus tumor under the nail may not be visible or it may present as a bluish discoloration localized over the tumor.

Typical signs and symptoms (pain, tenderness and temperature sensitivity), obvious during the clinical examination, along with patient history, are usually clear enough for the diagnosis. Ultrasound diagnostics is not used in our conditions because we do not have special probes available.

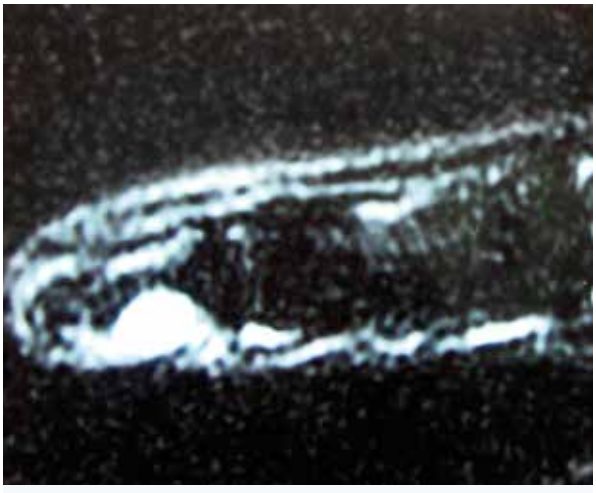

Fig. 1. MRI of glomus tumor (a sagittal view)

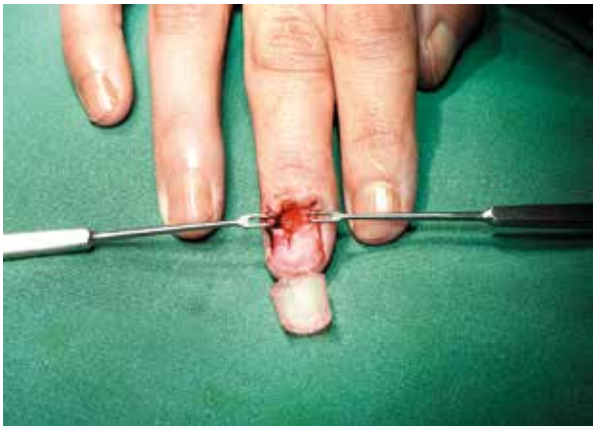

Fig. 2. Nail bed after removal of the glomus tumor

Fig. 3. Nail re-fixation

Currently, the gold standard for visualization and diagnosis of the tumor is magnetic resonance imaging (MRI), which is suitable for planning surgical management. (Fig. 1) Although specific symptoms for this disease are quite clear, there is still a delay between the time of onset of the symptoms to diagnosis and appropriate surgical therapy. The authors follow the time from the beginning of the symptoms until the diagnosis and then until treatment of the problem.

MATERIAL AND METHODS

The Outpatient Orthopaedic Department of the Hospital in Pardubice focused on hand surgery between the years 2004–2012. Totally 5 patients were diagnosed with glomus tumors of the distal phalanges of the hand. It concerned 3 women and 2 men, with an average age of 32.2 years (26–47 years). During the first examination, we monitored the duration of symptoms, number and speciality of the doctors who examined the patient and subsequent diagnostic procedures. All patients were clinically examined – monitored for the nail bed changes and a test was performed by immersion in cold water. When the cold test was positive, all patients underwent MRI that showed presence of a focus under the nail. The patients were indicated for surgical revision under local anaesthesia (4 patients) and one patient wished the procedure to be performed under general anaesthesia. The operation was performed in a bloodless field with the usage of magnifying loupes; the nail was released proximo-distally and after extirpation of the tumor was the nail bed closed with absorbable sutures. (Fig. 2, 3) For all surgery, the magnification was noticeable by attenuation of the soft tissues over the tumor. The tissue specimens in all patients were histologically verified. The patients were followed up for 2 years. At the first examination, we monitored how long the patient's discomfort lasted, how long the patients were examined and what examinations they underwent.

RESULTS

During the primary examination, it was found that patients suffered from clinical symptoms for an average of 2.4 years (0.5 years–6 years). In our group, each patient was examined by an average of 5.4 physicians (3–9 physicians). Speciality of the doctors by whom the patients were examined is shown in the Chart 1. The chart does not include general practitioners. The patient was sometimes examined by several doctors in case of one medical specialty. On examination before surgery, there were changes of the nail bed recorded in three cases and two patients showed no changes.

During the follow up of the patients for 2 years post-op, relapse occurred only in one case with the need for reoperation. After the reoperation, no complications or other relapse occurred. During the follow up 2 years after surgery,

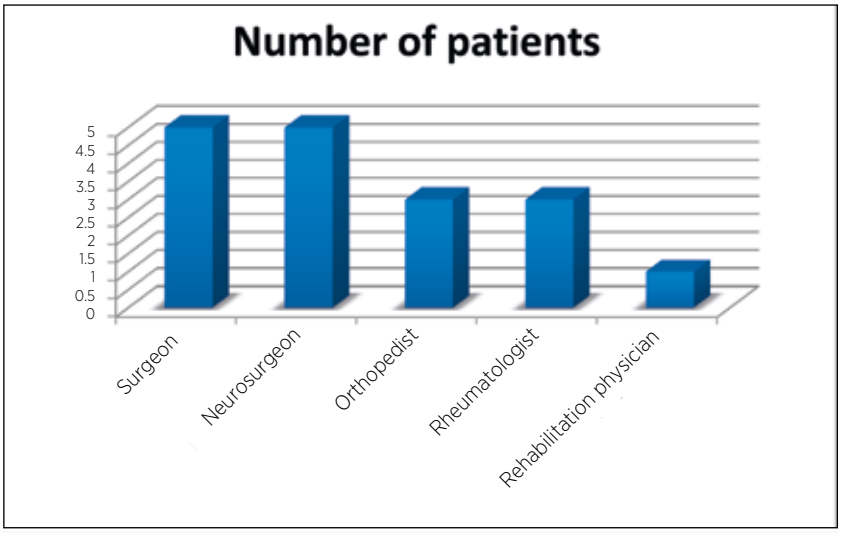

Chart 1. Physician's expertise and the number of patients who were examined

4 patients were without nail deformity. Only one patient had a deformity of the nail. In this case, the tumor covered nearly the entire nail bed and as a consequence it could not be reconstructed. Numbness of the distal phalanx was not recorded.

DISCUSSION

Because the glomus tumor is a rare lesion, occurring most frequently in the nail bed, its early diagnosis is still a problem. The patient is often referred to many specialists, who only exclude the cause by its physical appearance and from the point of view of their specialty.

Each patient was examined by an average of 5.4 doctors and the diagnosis was made after 2.4 years. In the literature, we often encounter a similar time frame from the onset of symptoms until proper diagnosis. Hamdi (2011) states the time of diagnosis 1.9 years and Assmus (2002) 8 years. Both authors report delays due to inaccurate diagnosis when patients were treated for different diseases.

Another widely discussed issue is what approach to use[3,4]. In case of the approach through the nail or its deflection, nail deformity is often described[5]. The same author also describes changes in the sensitivity of the nail and the distal phalanx[6]. To prevent nail deformity, Vasisht (2004) published the treatment of glomus tumor using the lateral subperiosteal approach as described by Garg (2016).[7,8] Lateral subperiosteal approach, where the authors prefer the lateral side after loosening of the nail side from the lateral tumor. Its advantage is seen in prevention of nail bed deformation. Both authors agree on the necessity for accurate preoperative diagnosis using magnetic resonance imaging of the location and the lesion to determine accurate access point. We believe that magnetic resonance imaging is not necessary if clinical symptoms are obvious and changes of the nail bed under the nail are obvious. If the clinical examination was positive but the tumor localization was not clear, we will perform magnetic resonance imaging to confirm the finding and to determine the size of the lesion. We did not indicate ultrasound examination because, after consultation with the radiologists, it was found that suitable equipment was not available.

In our department, postoperative deformity of the nail was recorded in only one case did not attribute to incomplete survival of the nail bed after the extirpation of the tumor. Relapse occurred in one case; it was our first patient, in whom the tumor was not completely excised. The reason was that the surgeon was worried about the safe treatment of the nail bed. For this reason, the tumor was not completely removed. The occurrence of multilocular forms, have not been encountered in our department, because these forms are very rare.

CONCLUSION

Although the clinical signs and symptoms of the glomus tumors are very obvious, there is still a long diagnostic period. It would certainly be ideal for patients with any persistent hand symptoms to be referred to a department, which specializes in hand surgery, where the diagnosis will be established faster, more effectively and which would be far more beneficial from the economic point of view.

Statement: *The authors declare that their work and documents are original and concurrently agree with publication.*

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CURRENT CONCEPTS IN PERIPHERAL NERVE INJURY REPAIR

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SUMMARY

Even though reconstructive surgery of the nerves underwent significant progress due to experimental and clinical research over the past 40 years, injuries to the peripheral nerves still remain a great challenge for microsurgery. Literature results of these procedures are often evaluated as very good but the final result is often characterized by an achievement of only a useful and not full function, which is rather rare. It is not only a simple suture; the success is also based on functional regeneration and interconnection of the nerve fibres. This is limited by correct surgical technique, the age of the patient, delay from the time of injury and the mechanism or localization of the injury. Some injuries even now remain untreatable (such as the most severe brachial plexus injuries or long traction injuries of the peroneal nerve). Apart from standard neurolysis and epi- or perineural suture with or without nerve grafts, distal nerve transfers (in case of proximal injuries) and end-to-side neurorrhaphy (mainly in trauma of sensitive nerves) have recently been frequently used. The future is however based on influence of nerve regeneration at the cellular level using substances with growth potential. The main prerequisite of successful surgery is however early indication of surgical revision in a specialized centre.

KEYWORDS

Peripheral nerve injury, nerve suture, nerve graft, nerve transfer.

INTRODUCTION

Injuries of the peripheral nerves are not rare. They affect 2.8% of trauma patients and result in considerable long-term disability, especially in hand trauma patients.[1] They are typically caused by cut or stub wounds in the forearm; lacerations or gunshots are rarer. Neurotrauma needs to be ruled out in every patient with an open limb trauma and at least a basic neurological examination needs to be performed. In case of a suspicion of nerve injury, it is necessary to refer the patient to a specialized centre for revision with possible urgent microsurgical reconstruction.[2] Traction injuries may occur in case of low energy trauma (lesion of peroneal nerve in the knee or radial nerve in case of humerus fracture),[3] as well as high energy trauma (brachial plexus palsy),[4, 5] where the nerve trauma is a typical part of a polytrauma.[6] Complete recovery is infrequent and usually limited to relatively minor injuries and reflects neurapraxia and axonothmesis. Laceration of the nerve has no chance of spontaneous recovery and the discontinuity has to be repaired.[1]

Despite good general knowledge of these injuries, the patients are often referred late for treatment. The aim of this review is to provide information about the basics of nerve anatomy and the pathophysiology of peripheral nerve injuries, as well as potential surgical interventions.

NERVE MICROANATOMY

The nerve fibre consists of an axon and associated Schwann cells. The diameter of an axon is 0.5–20 µm. Myelin sheath covers the axon except of a short segment after exiting from the neuron and at the terminal branching. Schwann cells create the multilayer myelin sheath of myelinated axons by wrapping around the fibre several times during its development. At the site of contact of individual Schwann cells there are areas without myelin cover, so called nodes of Ranvier. The area between two nodes is called an internodal segment, which is longer with thicker fibres.[7] The node of Ranvier is also the area where collateral sprouting of axon occurs.[8] Non-myelinated fibres have a cover consisting only of Schwann cell folds, which thereby simultaneously "cover" more axons. Apart from production of myelin sheath of the axon, Schwann cells are also a source of growth factors necessary for survival as well as for regeneration of nerve fibres. In case of an injury, neurotrophins are produced in the distal as well as proximal stump and create a suitable environment for re-inervation.[9, 10]

Nerve fibres are not parallel with the surface of the nerve, but they are undulated. This phenomenon is visible macroscopically as so called bands of Fontana[11] and it is one of the basic prerequisites for successful microsurgical suture, since the stumps of the nerve may be pulled back towards each other in a limited distance even after their retraction.

Due to the curved arrangement are the nerve fibres up to 20% longer than the actual nerve and therefore it is possible to achieve connection without tension even after short stretching of the nerve.[12] Bands of Fontana are not present in the intracranial segment of cranial nerves or in the spinal roots. Banding has also its physiological significance since it enables stretching of the nerves during joint movements. The basis for undulation is a specific structure of endoneurium, which covers the nerve fibre.[13]

Nerve fibres are organized into fascicles. This arrangement plays an important role in surgical techniques treating nerve injuries. Fascicles are wrapped with perineurium and the whole nerve is separated from the surrounding tissues by epineurium, which is a vascularized tissue that proceeds to mesoneurium, i.e. supportive connective tissue at the site of entry of the vascular bundles.[14] Regarding surgery, it is important to maintain the vascular supply of the nerve, which usually originates from a concomitant artery. Many supplying arteries with a diameter of 0.5–1 mm grow distally and their length is 5–15 mm, occasionally even 25 mm. The nerve may be therefore mobilized without their injury only for a short distance. In case of damage to the nutritive vessels (e.g. in the ischiadic nerve in the gluteal area or in the median nerve in the proximal forearm) there exists a possibility of nerve ischemia. Quantity of fibrous tissue grows in the area around the joint and in the nerves with greater quantity of small fascicles. Number of fascicles is significantly variable in various nerves and ranges from one to a hundred, while each can contain up to 10 thousand axons.[14] The structure of the nerve in a section in the proximal segments is significantly disorganized and organization increases with more distal localisation. This phenomenon significantly complicates surgery of proximal injuries, while it is sometimes very difficult to impossible to determine corresponding fascicles in case of injuries with loss of tissues.[15]

TYPES OF NERVE INJURIES

Traction injuries occur when the elastic capacity of the nerve that is based on collagenous endoneurium is exceeded. These are typical for injuries of the brachial plexus; they are frequent at the level of the knee with the injury of the peroneal nerve or in case of fractures, typically fracture of the humerus with the injury of the radial nerve. In lacerations, the nerve may be completely interrupted, however, more common is an injury with interruption in the continuity with partial division of the nerve diameter. They comprise up to 30% of all nerve injuries.[12] Nerves may also be injured by compression, e.g. so called "Saturday night palsy" of the radial nerve (falling asleep with arm leaning on an edge of a bar) or entrapment syndromes (nerve compression). Pathophysiology is not completely explained; there is a possibility of complete loss of sensory and motoric functions. Lesions are attributed to a combination of compression with ischemia, however it is not clear, which of the two is predominant. Histologically there are no obvious changes and injury is reversible, if ischemia lasts less than 8 hours.[16]

The process of changes that occur after nerve injury was first described by Waller in 1850,[17] while the conclusions about degeneration and subsequent regeneration of the distal stump (and a small segment of proximal stump) are valid till now. The basic Seddon classification [18] to neurapraxia ('concussion' of the nerve, temporary loss of conductive function), axonotmesis (interruption of axons without injury to mesenchymal parts) and neurotmesis (interruption of a nerve) was subsequently extended by Sunderland [14] to five degrees – injury to myelin, axon, endoneurium, perineurium and epineurium.

NERVE DEGENERATION

Distal segment

In neurapraxia there are no histological changes; functionally it is only a conduction block. In axonotmesis, there may be various morphological changes. This can be Waller degeneration, which starts within several hours after the injury and is based on fragmentation of axon and myelin distally from the site of injury. There is loss of axonal continuity with loss of conduction in axon within 48 - 96 hours after the injury. Decay of myelin occurs between 36 and 48 hours. Schwann cells play a key role in this whole process. The degradation process ends in 5 to 8 weeks and its result is presence of nerve fibre residues consisting of endoneurium filled with Schwann cells. These changes are more apparent in case of neurotmesis. After interruption of the fibres, retraction occurs due to the effect of elastic endoneurium, swelling at the site of interruption and haemorrhage resulting in local inflammatory response. Activation of fibroblasts leads to scaring on the ends of the nerves as well as between the fascicles. The stumps are therefore thicker than a healthy nerve; the whole area is also fixed with a scar to the surrounding tissue. In case of the 4th and 5th degree, there are - apart from obvious motoric and sensitivity disorders in the appropriate nerve supply area - also vasomotor and apocrine dysfunction due to interruption of efferent sympathetic fibres with the development of red dry skin in the area without innervation. [2]

Apart from the periphery, there is also the central part affected. In the first phase there is significant proteosynthesis as a preparation of the neuron to repair the defect. If there is no conductive structure present in the distal stump with appropriate microenvironment, there is a great amount of grow cones growing from the axon (50–100), which together with Schwann cells and connective tissue form a neuroma. In case of opposite situation, there are several grow cones, which grow to the distal stump.[19, 20] Columns of Schwann cells are called bands of Büngner. Their main function is guidance and support of the newly growing axon by the presence of adhesive molecules and enzymatic activity. Schwann cells are also able to migrate in a limited extent to the space between the distal and proximal stump of an interrupted nerve. They create some kind of bridge together with fibroblasts and fibrin matrix, which participates during navigation of growing axons. In case of unsuccessful reinervation, Schwann cells undergo regressive changes and Büngner columns become atrophic and their number is significantly reduced within several months.[21]

In case of 4th to 5th degree of injury, the situation is more complicated. The continuity of the axon as well as connective parts of the nerve is impaired. Interrupted ends are significantly macroscopically changed; they create an oedematous mass of disorganized Schwann cells, capillaries, fibroblasts, macrophages and collagen. Regenerating axons are usually stopped by a new scar already before they reach the end of the proximal stump, some of them grow through the scar to the surrounding tissue and part of them change the direction of growth and grow back to the proximal stump. Small part of them can reach the distal stump, as long as the gap

in-between is not too wide, but even then, there is a new scar that prevents further growth.[22]

Proximal segment

The extent of changes in neurons and fibres proximally from the injury depends on the extent of the injury and distance from the cellular body. In a small distance from the site of injury, there is degeneration of Schwann cells with reduction of myelin and thickness of the axon. These changes could be only minimal, extending to the first Node of Ranvier or it could affect the whole length up to the cellular body. The second option occurs if there is also apoptosis of neuron associated with the injury. The whole proximal segment then undergoes Wallerian degeneration and it is subject to phagocytosis.[23]

The damaged neuron is then subject to changes within the first six hours after the injury. Firstly chromatolysis occurs. The change corresponds to increased metabolic activity of neuron during axonal regeneration. Proteosynthesis continues in the case of a nerve suture, when the proximal stump is near to the Schwann cells of the distal stump that produce growth factors. If there is no reconstruction performed, neurons undergo gradual atrophy and this process ends with their extinction. The total quantity of dead neurons is not known. For example apoptosis of cells in a spinal ganglion after axonotmesis affects 20 – 50% of neurons.[23]

NERVE REGENERATION

Wallerian regeneration in case of severe injuries starts only after a previous degeneration. Human peripheral neurons have a capacity to start sufficiently strong regeneration within a period up to 12 months after an injury and massive response is possible also after repeated injury. In the cases of neurapraxia and axonotmesis, there is always functional restoration achieved. This occurs frequently after overcoming the conduction block, or later after axonal reparation. Injuries do not leave any significant functional or morphological consequences.[14]

In cases of more severe injuries with impaired endoneurium, there is a loss of axonal support for their distal growth. They grow partially to the surrounding tissues or to non-adequate endoneural tubes. Functional result is therefore significantly limited and it is dependent on the severity of the impairment. More severe injuries are associated with scars. Axons must first find a way to a newly constituted or distally preserved endoneural tube. The distal stump may contain more axons at the end of reparation than the proximal stump due to collateral division.[21]

Generally accepted average speed of axonal growth is 1 mm per day, although it can reach 0.5 to 9 mm daily. These differences are due to several variables. Regeneration speed declines with increasing distance from the neuron and higher age. Differences also exist between sensory and motoric axons. The growing axon is often associated with the presence of a positive Tinel´s sign, i.e. pain on percussion over the area of current position of axonal cone.[16, 22]

Axonal outgrowth and regeneration across and into the distal nerve stump may be slowed down by specific inhibitory molecules, especially some types of glycoproteins.[24]

The studies have shown that advanced age correlates with poor prognosis even after technically successful nerve repair. Schwann cells in the aged animal pose a primary impediment to axon regeneration in older animals as they fail to support regenerating axons.[1]

CHANGES IN TARGET ORGANS

In case of denervation, the target organs undergo characteristic changes. These are progressive atrophy (more than 60% of mass and 90% of maximal strength during the first six months after denervation) and subsequent fibrosis of muscles (occurring in a variably long time, usually within two years after denervation). These changes are dependent on the speed at which regeneration of the neuro-muscular connection occurs. This time consists of not just the duration of actual nerve regeneration after reconstruction, but also latency between injury and operation. Prolonged division of an axon, which takes more than six months before repair, results in up to two-third reduction of regenerating motoric axons.[16, 25] Immobilisation inducing degenerative changes of the joints and adjacent structures (i.e. ligaments and tendons) could contribute to the worse result.[26]

ACCELERATION OF RE-INERVATION DURING SURGICAL THERAPY

It has been recognized, in general, that the time frame between the injury and re-inervation (i.e. successful connection of regenerated axons to the motoric endplates) should not be longer than 24 months, which in case of a lesion of the lower part of brachial plexus virtually excludes the possibility of re-inervation of small muscles in the hand and it also makes re-inervation of the forearm muscles more difficult. This does not apply, however, to the cranial nerves, while for example in the facial nerve it is possible to achieve re-inervation in some cases even several years after the injury.[27] This problem can be solved either by acceleration or support of axonal growth (using trophic factors, currently only in an experimental phase) [28, 29] or by connection of the source axons closer to the target muscle using a donor nerve, i.e. nerve transfer. This changes the proximal lesion to a distal one.[30]

Speed of regeneration may be effectively influenced by electrical stimulation. A brief period of electrical stimulation of 1 hour was shown to be as effective as continual stimulation for promoting both motor and sensory regeneration. It mediates its effect at the level of axonotomized neurons, dominantly by upregulation of BDNF and its trkB receptors followed by upregulation of cytoskeletal proteins and GAP-43 in motor neurons.[24]

TIMING OF SURGICAL PROCEDURE

According to the type of injury, it is possible to use the *rule 3 x 3* in practice: [2]

– **Immediately, or within 3 days** – sharp clean injuries (cut or stab wounds), where finding of the distal stump may be facilitated by electrostimulation (distal segment is conductive for up to 72 hours after interruption). Every injury is an acute condition. It is therefore advisable to perform immediate revision, which usually enables suture without the use of grafts.

– **Within 3 weeks** – lacerated dirty wounds (bites, extensive lacerations spoiled with e.g. soil, gunshot wounds,

Grade 0	Complete paralysis
Grade 1	Minimal contraction
Grade 2	Active movement with gravity eliminated
Grade 3	Weak contraction against gravity
Grade 4	Active movement against gravity and resistance
Grade 5	Normal strength

Table 1. Classification of motor recovery according to the MRC scale[14]

large vascular reconstructions) after primary treatment with antibiotics and cleaning of the wound, suture of tendons, muscles and vessels. If there is the end of the nerve found, it is suitable to mark it with Silon suture. Within 3 weeks after the injury, destructive changes begin on the ends of the stumps with the development of the so called *terminal neuroma*. Delayed surgery is performed to define the scope of nerve injury and to achieve sufficient resection of neuroma, which, if left in place, may lead to unsuccessful regeneration. After cutting it with a "salami" technique it is sure that healthy-appearing nerve tissue will not be changed anymore.

– **In 3 to 6 months** – all closed injuries after EMG examination demonstrating persisting complete denervation syndrome of a particular nerve. In cases of isolated functional impairment (neurapraxia), the function starts to restore in about 3 weeks. In case of axonotmesis, it is possible to expect at least electrophysiological changes of re-inervation in 2–3 months. Their absence suggests either compression of a nerve by a scar or neurotmesis (i.e. neuroma in continuity or nerve rupture).[31]

NEUROLYSIS

In cases of blunt closed injuries, there is a possibility that during surgery it is found that the affected nerve segment – the so called *neuroma in continuity* - is still conductive, i.e. it is possible to trigger nerve action potential (NAP positive). In these injuries, it is indicated to perform simple nerve release, i.e. neurolysis. Currently, there is mostly *exoneurolysis* performed, i.e. dissection of the nerve from the surrounding scar tissue, which is possibly supplemented with epineurotomy. *Endoneurolysis*, i.e. dissection of the nerve to individual fascicles has no justification at present. On the contrary, there is a risk of subsequent excessive intramural scaring with deterioration of the condition.[32]

If the affected neuroma is not conductive (NAP negative), there is always a scar palpable and usually also grey-violet colour of a particular segment. This segment is removed at the assumed border and both ends are cut with gradual salami technique up to macroscopically healthy tissue with visible fascicles. Then, one of the following reconstructive techniques is used.[12, 14, 18]

RECONSTRUCTIVE TECHNIQUES

Nerve reconstruction should follow some basic principles. It is necessary to perform suture under magnification by using a microscope or loupe glasses. Nerve stumps have to be adequately oriented by observation of vascular pattern and diameter of each fascicle and sutured by 8–0 to 10–0 sutures without tension. [2, 12]

Two basic techniques of nerve suture are used. Based on long term experience and large groups, it is not possible to definitively state, which technique is better. The result depends on several variables – time from injury, the age of the patient, mechanism of the trauma, type of nerve, composition of the fibres in the nerve (pure motoric and sensitive or mixed) and localization of the injury.[2] Proximal injury is worse due to two reasons: 1. longer re-inervation route, 2. fascicles, mainly those intended for distal structures, are mixed and in their course are mutually connected. Each motoric and sensitive fascicle is well formed up to the distal area.

Last but not least, the result is influenced by the length of the defect between the stumps (tension, usage of a graft) or simultaneous vascular injury with ischemia.[32]

Epineural suture – the nerve is sutured with microsurgical technique to epineurium after approximation of both ends and microsurgical removal of its external layer usually by 8-0 suture.[32]

Fascicular (perineural) suture – performed in perineurium or in interfascicular epineurium with greater microscope magnification. The method enables better coaptation of fascicles; it is advantageous in distal injuries, i.e. in areas with several well-differentiated large fascicles. It is used mainly as group fascicular technique, during which are mutually connected certain groups of corresponding fascicles in the nerve. It is advisable to use fine monofilament sutures (usually 10-0).[12] However, the technique is associated with greater trauma and scaring to the healing nerve internally due to presence of permanent sutures. Therefore, fascicular repair has no functional superiority over epineural suture.[1]

Adhesion with fibrin glue – method originally developed to prevent scaring associated with each suture and acceleration of surgical procedures. Use of fibrin glue may be associated with the occurrence of dehiscence and for stability of the connection it is possible to use one or two stitches.[33, 34] Experimental studies have shown that the use of glue results in less granulomatous reaction at the site of the suture and better axonal regeneration. The changes are not very significant,[35] and moreover there was no controlled human study performed to confirm the differences between the methods.[36]

In every injury, even in a clean cut, there is a defect between the stumps based on nerve retraction.[37] In case of more severe or late treated injuries is retraction greater due to intramural fibrosis, and of course there is a defect in case of a possible injury with soft tissue loss. To achieve suture without tension, it is necessary to eliminate the defect or replace it:

Techniques that enable shortening of the defect

Stretching of the stumps – this is enabled by the undulated course of the nerve fibres (bands of Fontana). It is possible to stretch only the stumps in fresh clean sharp injuries, where retraction is minimal (1–2 cm). If stretching is more than 5% of the length of the nerve, there is reduced blood perfusion in vasa nervorum of the nerve and in cases more than 15%, the perfusion stops.[38]

Mobilisation of the nerve – cutting of the supportive mesoneurium and release of the nerve from the surrounding tissues. The disadvantage is reduced vascular supply of the particular segment, therefore the released segment should not be longer than 6 to 8 cm. Mobilisation enables shortening of the defect by 2–4 cm.[39]

Transposition – in case of nerve mobilisation supplemented with a shift to a position, which is more in the line

with further course of the nerve. This is used typically in ulnar nerve injury in the elbow, when its transfer over the medial epicondyle enables shortening of the defect by 3–5 cm. The method may be used in the radial nerve, which may be moved ventrally over the humerus with a gain of up to 3 cm.[12]

In case of bigger defects, none of the aforementioned methods can shorten the distance between the stumps and for the success of the procedure it is necessary to use a graft to bridge the gap. The great results of Millesi [40] and Samii [41] in the 70's and 80's of the 20th century contributed to a wider use.

Bridging of the defect with grafts

In cases where it is impossible to achieve tension-free suture of nerve stumps, the gap between them must be bridged. Use of an autograft remains the most reliable method. Three conditions must be fulfilled for the best result during the use of a graft:

1. The graft should cover the whole diameter of the affected nerve

2. It is commonly advised to choose a graft that is 10–20% longer than the gap to ensure a tension-free suture

3. The nerve must be well nourished.[42] Diffusion to the central areas of the graft can be ensured only in thin nerves.[31] The critical diameter of the graft is 2 to 5 mm.[41] This condition may be fulfilled with the use of several grafts with a smaller diameter. With the increasing number of grafts, declines diffusion capacity. It has been shown however, that with the use of two anastomoses while avoiding tension in case of the graft, are achieved better results than in case of one anastomosis without a graft under tension.[40-42]

In case of oligofascicular nerves, it is possible to use interfascicular connection. In larger nerves it is, however, currently the preferred cable technique. This is when the grafts are sutured between the stumps of the nerve to cover most or whole diameter of the affected nerve.[43] The most frequently used donor remains the sural nerve. In case of surgeries on the upper limb, it is possible to use the lateral cutaneous nerve of the forearm. Generally, it is possible to achieve restoration of function in grafted great nerves (median and ulnar nerve) in about 60% of cases. Better effect may be expected in the sensory component of the nerve.[44]

It has been well documented that nerves might regenerate across a short nerve gap through various conduits, such as veins, pseudosheats or bioabsorbable tubes. Vein grafts have been successfully used to reconstruct distal sensory nerve defects.[1] However, there was no alternative found yet, which would have the same good regenerative capacity as a nerve graft in an experiment.[45]

Nerve transfers

Nerve transfer is a method that uses an intact, functionally less important donor nerve as a source of axons for the injured nerve in cases when the proximal stump cannot be used for repair (avulsion of cervical roots or severe injury of the proximal stump with a loss of tissue). The donor is interrupted and its proximal stump is sutured to the distal stump of the reconstructed nerve (recipient). The benefit of this technique is only one neurorrhaphy site (contrary to graft repair) shortening of regeneration time because it minimizes the distance over which a nerve has to regenerate.[25, 46] The technique is typically used in brachial plexus injuries. It is possible to use intraplexal (from the plexus – e.g. pectoral nerve, thoracodorsal nerve, etc.) and extraplexal nerves (spinal accessory nerve, intercostal nerves, phrenic nerve) for neurorrhaphy, whereas the loss of function of a certain muscle while sacrificing its nerve must always be outweighed by the expected result. Recently, there has been popular reconstruction of proximal ulnar nerve injuries with a transfer of the distal end of the anterior interosseus nerve (from median nerve) to the deep branch of the ulnar nerve [47, 48] or injuries to the median nerve by suturing the same nerve to its recurrent branch at the level of the wrist.[48, 49] Apart from the brachial plexus, there were also described nerve reconstructions using surrounding donors on the lower limbs. These are however isolated case reports only.[2]

In certain cases it is possible to find a compromise solution, i.e. partial preservation of function and also reinervation of the recipient. Apart from the popular technique with the use of one of the branches of the radial nerve for the triceps muscle for reinervation of axillary nerve it is a fascicular transfer and end-to-side neurorrhaphy. [50]

Fascicular transfer was firstly described by Oberlin in 1994 (hence so called Oberlin's technique) as a transfer of motoric fascicle of the ulnar nerve for the flexor carpi ulnaris muscle to the musculocutaneus nerve.[51] Later was described similar procedure in the median nerve with harvesting of a fascicle for pronator teres muscle and for flexor carpi radialis muscle.[52] The technique has generally very good results and it can be used in cases of injuries of the upper roots of the brachial plexus. The fascicle, which is found with electric stimulation after opening epineurium of a particular nerve, is subsequently divided and its proximal stump is released in a length of several centimetres. This stump is then sutured to the distal stump of the reconstructed nerve.[53] Due to the short reinervation route this technique is usable in older injuries, which are treated in more than one year after the injury.[54] Recently, this technique has been used with good results in the reconstruction of axillary nerve.[55]

End-to-side neurorrhaphy of peripheral nerves is based on the fact that apart from the terminal branches, the axons are also capable of dividing within their course. This is termed collateral sprouting. The principle of the technique is connection of the distal stump of the affected nerve to the side of an intact donor nerve after the creation of a perineural window.[56] The technique is mainly used in reconstruction of digital nerves.[57] It has very limited effect on greater nerves.[58]

INJURY TO THE PERIPHERAL NERVES IN CHILDREN

Lesions of the peripheral nerves in children are less common in comparison with the adult population. More frequently occurring are peripheral nerve injuries in association with fractures of the limbs. Closed injuries predominate and among these fractures most common are supracondylar fractures. Neural lesions are almost exclusively of neurapraxia or axonotmesis type, interruption of anatomical continuity of the nerve stem is very rare. Treatment of these blunt injuries is conservative, even in case of a full denervation syndrome it is possible to wait for several months. Open injuries of peripheral nerves in childhood occur by cutting, mostly by glass from windows or doors and dishes.

Consequences of peripheral nerve injuries with regards to pathophysiology are the same as in adult patients. The results

Grade S0	No recovery of sensibility in the autonomous zone of the nerve
Grade S1	Recovery of deep cutaneous pain sensibility within the autonomous zone of the nerve
Grade S1+	Recovery of superficial pain sensibility
Grade S2	Recovery of superficial pain and some touch sensibility
Grade S2+	As in S2, but with overresponse
Grade S3	Recovery of pain and touch sensibility with disappearance of overresponse (s2PD > 15 mm)
Grade S3+	As S3, but localisation of the stimulus is good and there is imperfect recovery of s2PD (7–15 mm)
Grade S4	Complete recovery with s2PD < 7 mm

Table 2. Classification of sensory recovery according to the Mackinnon-Dellon scale.[60] s2PD – static sense of two-point discrimination

of healing depend on the age of the child. Neuronal activity of injured peripheral nerves restores very quickly in very small children, axonal regeneration occurs with a rate up to 5 mm per day and the results of healing of injured peripheral nerves in children are therefore better than in adults. This is attributed mostly to neural plasticity of the nerve tissue.[59]

Timing of surgical revision of injured peripheral nerve in children is the same as in adult patients; also usage of perioperative electrophysiological monitoring is mandatory. The preferred surgical techniques in children that are used are exoneurolysis, anastomosis with a graft, primary anastomosis and removal of neuroma in continuity.

POSTOPERATIVE COURSE

Sutured area reaches the original strength in 2–3 weeks. The limb should therefore be fixed for this period of time. In more complex injuries requiring tendon or muscle repair, the limb must be fixed for longer period of 4–6 weeks. Alternatively, after two weeks of immobilization, a dynamic splint may be used. Then it is necessary to start with intensive daily rehabilitation, electrostimulation of denervated muscles and sensitive stimulation of denervated skin.[60] There is also a crucial role for custom-made orthosis applied usually during the night as a prevention of flexion contractures. The patient must be instructed about minimal latency between operations and primary signs of reinervation. This lasts usually around one year; the first electrophysiological signs of reinervation may be sometimes noted six months after the procedure.[32]

ACHIEVEMENT OF DEFINITIVE STATUS

There is an agreement currently that for evaluation of the definitive status, there is two-year period of observation necessary.[32] Muscle strength is most frequently tested with the MRC system (Medical Research Council, Table 1).[14] Evaluation of sensitivity is most important for reconstruction of median and tibial nerve. Most commonly used is the scale of Mackinnon and Dellon (Table 2).[61]

In case of unsuccessful (or functionally ineffective) reinervation of the affected nerve, which occurs in 20–30% of nerve injuries, secondary correction methods may be used for restoration of limb function. These are tendon or muscle transfers and muscle transposition procedures.[62]

CONCLUSION

Nerve injuries deserve our attention in spite of low incidence due to common serious morbidity caused by denervation of affected muscles and skin. The outcome of surgical therapy is often good. However, such results may be achieved only with timely revision. In case of sharp injuries ideally within 72 hours and in closed lesions between 3 and 6 months from their occurrence, if there are no signs of regeneration. Irritation due to compression after fractures or iatrogenic injuries can be solved even later. The most important request is therefore the timely referral of the patient to a specialized unit where the microsurgical repair, including nerve grafting, is possible.

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SUBACUTE ARTERIAL BLEEDING AFTER SIMULTANEOUS MASTOPEXY AND BREAST AUGMENTATION WITH IMPLANTS: CASE REPORT

ACTA CHIRURGIAE PLASTICAE, 59, 2, 2017, pp. 92–96

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SUMMARY

Breast augmentation with implants is one of the most commonly performed plastic surgery procedures. The goal of the operation is to increase the size, shape or fullness of the breast. It is accomplished by placing silicone, saline or alternative composite breast implants under the chest muscles, fascia or the mammary gland. This type of operation is no exception with regards to concerning the occurrence of complications. The most common early complications include an infectious process, a seroma, and a hematoma, and the late ones include capsular contracture, reoperation, implant removal, breast asymmetry, and a rupture or deflation of the implant. The authors present a case of subacute arterial bleeding after simultaneous mastopexy and breast augmentation with silicone implants in a 27-year-old woman. The patient complained of worsening swelling and pain in the right breast. The patient denied having had any traumas. Ultrasonography indicated 2.5 cm heterogeneous fluid collections around the implant. Therefore, revision surgery was performed, and a hematoma of 650 mL was removed. Hemorrhage from a branch of the internal mammary artery was found. After the revision, the implant was returned to the lodge. The postoperative period was uneventful. This case report presents a description of a subacute hematoma after simultaneous mastopexy and breast augmentation with silicone implants, which is an extremely rare complication in aesthetic surgery.

KEYWORDS

Breast augmentation, hematoma, complication, aesthetic, breast

INTRODUCTION

Breast augmentation surgery with implants is performed when breasts are small, underdeveloped or wilted after breastfeeding, or for shape improvement in case of asymmetries, in order to increase self-confidence[1]. Breast shape, size, and appearance is influenced by many factors, the most important of them being age, heredity, weight changes, pregnancy, sun exposure, physical activity, and congenital disease. Breast implants are also used to restore the breast after mastectomy, sex reassignment surgery, etc. Like any other operation, this procedure also has its general risks. However, some complications like bleeding to the lodge of the implant after surgery, infection, fluid accumulation around the implant, capsular contracture, implant rotation, and implant rupture are specific to this procedure[2,3]. In this case, subacute spontaneous arterial bleeding occurred. This type of postoperative complication is very rare because after almost 40 years from the first publication of spontaneous bleeding after breast augmentation with implants[4], not more than 20 clinical cases have been presented[5]. This case report presents a description of a subacute hematoma after breast augmentation with silicone implants, which occurred 5 weeks after the surgery.

CASE REPORT

A 27-year-old woman applied for a breast reshaping surgery for aesthetic purposes. There were no other complaints in her medical history. The patient underwent simultaneous mastopexy according to classical Lejour vertical scar technique and breast augmentation surgery using round silicone (Allergan) TSF – 415 mL implants under the pectoral muscle and a breast lift under general anesthesia (Fig. 1). During the operation proper hemostasis was achieved using electrocoagulation. Drains were removed next day after the operation with minimum serohemorrhagic fluid volumes. The subsequent postoperative period was also uneventful.

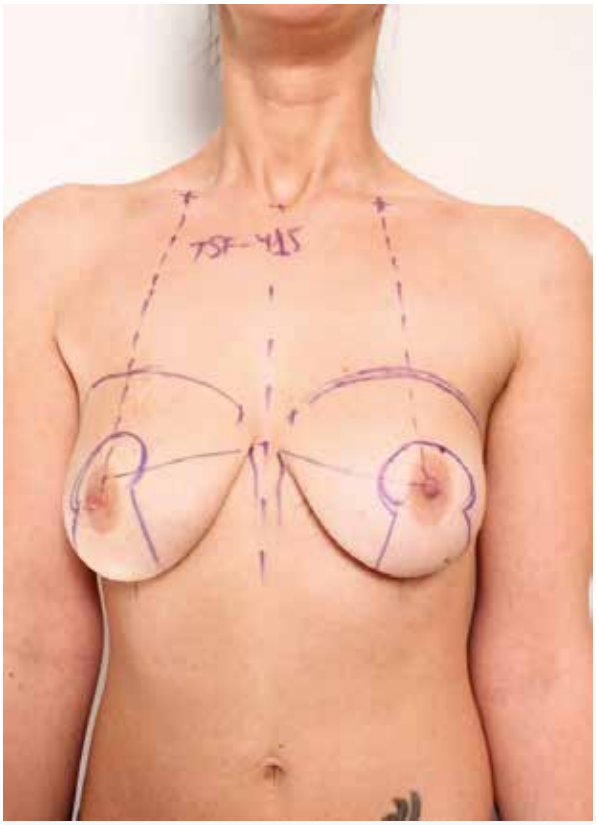

Fig. 1. Patient before the operation

The patient was discharged from the clinic on the second day after the surgery. Five weeks after the operation the patient arrived to the clinic because of tenderness and swelling of the right breast. The patient stated that she had not sustained any traumas. During clinical examination, the upper right breast area was found to be significantly swollen and firm (Fig. 2). Ultrasound examination showed a 2.5 cm heterogeneous strip of fluid accumulated around the implant (Fig. 3). The implant was intact. Complete blood count showed an increased amount of leukocytes, and red blood cells and hemoglobin were at the lower limit of the normal level. No coagulopathies were found. The patient was taken to the operating room where she underwent revision surgery. The purpose was to remove the fluid and to find and stop the cause of its accumulation. During the operation (Fig. 4), a blood clot of 650 mL was removed (Fig. 5). Bleeding from one of the internal mammary artery branches in the implant pocket between the rib cage and the pectoral muscle lower pole was detected and stopped. After the revision, the implant was returned to the lodge. Vacuum drainage was used for one day only. One year after the surgery, there was no recurrence of bleeding, and there was no clinical evidence of the implant capsule contracture formation found either. (Fig. 6).

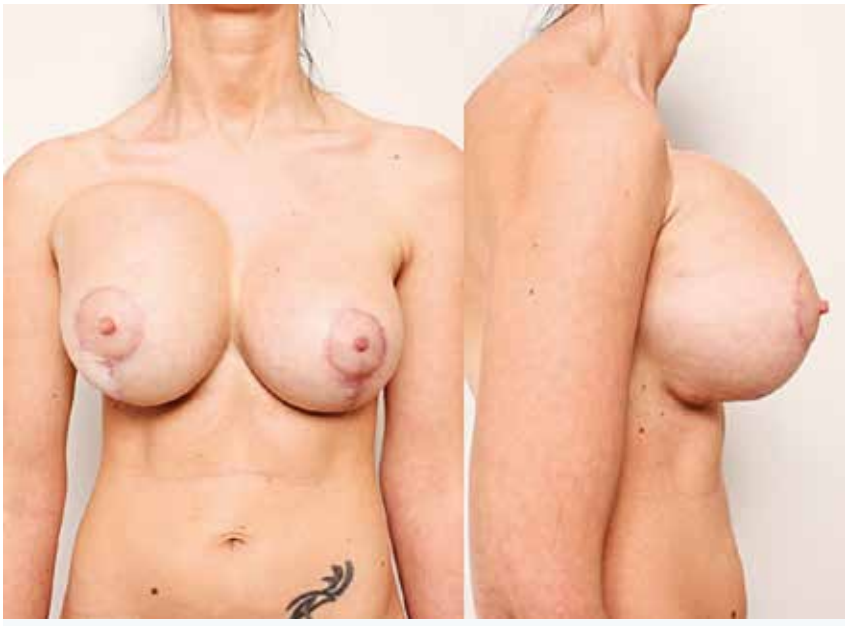

Fig. 2. Hematoma of the right breast showing gross enlargement. Preoperative view

DISCUSSION

Breast augmentation with implants may lead to early or late complications, bleeding being one of the early complications[6,7]. Bleeding control is number one priority for any surgeon. Hematoma as a complication of breast enhancement with implants usually occurs within three days after the surgery[8], and its incidence is 2% to 10.3% of all breast augmentation operations[4, 9–12]. We presented a case of a subacute hematoma appearing five weeks after the surgery. Hematomas occurring after breast augmentation are classified into three groups: acute hematomas appear from 3 to 7 days after the surgery, subacute hematomas occur from 7 days up to 3 to 5 months after augmentation, and late hematomas appear 3–5 months or more after mammoplasty[15]. The cause of acute hematoma after breast augmentation with implants may be inadequate hemostasis during surgery or a congenital, acquired or drug-caused coagulation disorder. Trauma is also one of the factors. The first reported case of a late hematoma was published in 1979 by Georgiade et al.[4]. Hematoma appeared 2.5 years after the surgery. Authors suggested that the cause of bleeding was a large dose of corticosteroids used in the saline implant. In 2002, Hsiao et al. reported two cases on late hematomas[10]. The first one occurred two years after the surgery, and the second one – a year postoperatively. In both cases, saline-filled, textured silicone prostheses without corticosteroids were used. The cause of the bleeding was only identified in the second patient – neovascularization on the inner surface of the capsule was found. It is thought that mechani-

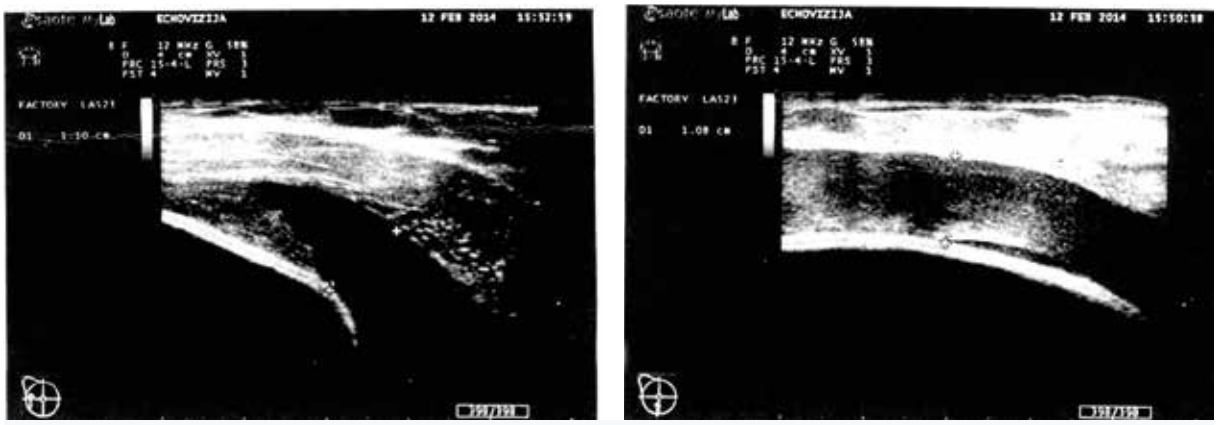

Fig. 3. Ultrasound evaluation showing liquid accumulation

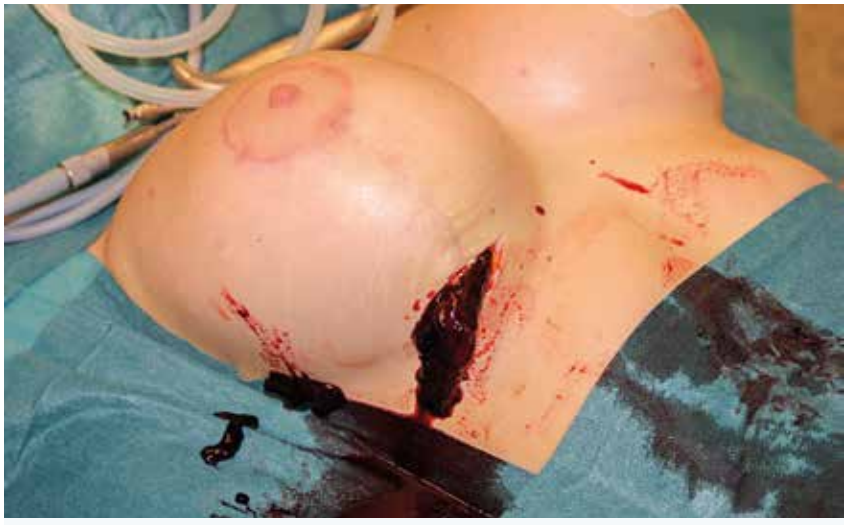

Fig. 4. Perioperative view

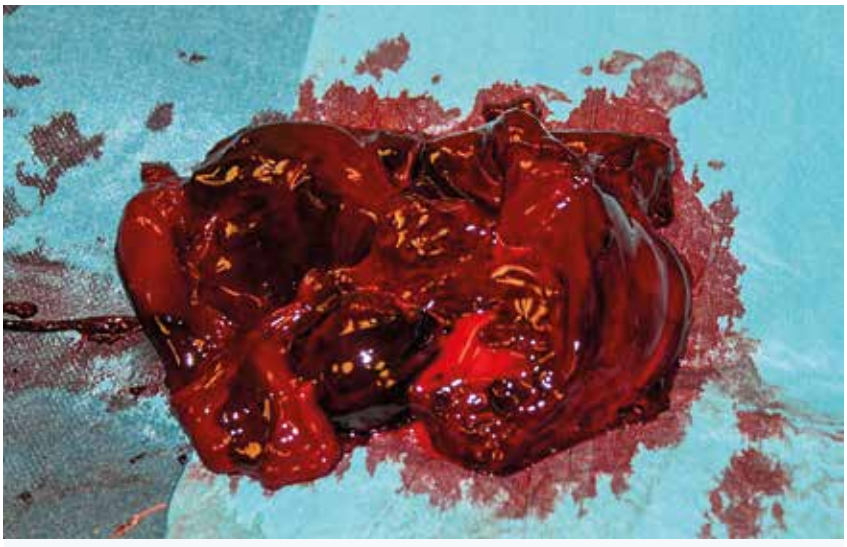

Fig. 5. Hematoma of 650 ml

cal friction between the textured surface of the implant and the high vascular capsule may result in an intracapsular hematoma. In 2009, McArdle and Layt described a case of a late hematoma, which occurred 12 months postoperatively[13]. Gel-filled implants were used in this patient. Operative examination showed no signs of bleeding. Supposedly, the subsequent traumatization of the new neovascularized capsule might have been the cause of the late hematoma[9]. In 2014, Peters et al. hypothesized after examining 5 patients with a late unilateral hematoma that bleeding was associated with microfractures in the implant capsule[14]. The histological analysis of the capsules showed that there was episodic bleeding and reorganization of the hematoma, and the vascular spasm of the damaged vessel was impossible because of the rigidity of the capsule. Late hematomas after breast augmentation with implants also occur because of a sudden rupture of the implant and the capsule, usually – due to the effect of an external force. An increasing chronic hematoma may appear when chronic inflammatory processes are active, the friction force between the surface of the implant and capsule is high, manifestations of coagulopathies are seen, there is a probability of capillary damage because of the rigidity of the capsule, or steroids are used. Nasr et al. reported a case of a subacute hematoma that developed three weeks after the augmentation mammoplasty[15]. In this case, mild physical stress was sufficient

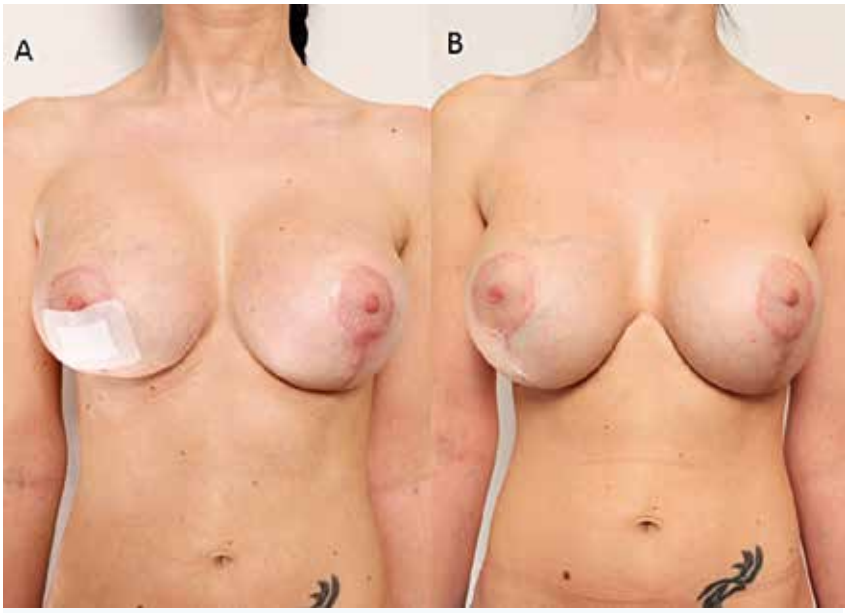

Fig. 6. Patient 2 weeks (a) and twelve months (b) after a revision surgery

to trigger bleeding from a branch of the internal mammary artery because it was eroded by the friction between the implant and the vessel. In our case, the cause that triggered bleeding was unknown. The patient denied trauma, use of anticoagulants or a history of any coagulopathies. Classical Lejour vertical scar technique for the breast lifting affects skin, subcutaneous fat and glandular tissues[16], but there is no influence to the pectoral muscle and its vascularization. In our case no suspension sutures were performed to the muscle underneath. Damaged bleeding artery was found in the implant pocket under the muscle in the border where the lower internal pectoral muscle pole attaches to the ribs and sternum. If the artery was on tension even a slight displacement of the implant in condition of a scar formation could have made damage. Also this theory makes sense with big and high profile silicone implants because of the mechanical tension to the muscle and other tissues. We believe that the treatment tactics for acute and subacute hematomas after breast augmentation with implants should be revision surgery – an inframammary incision with subsequent evacuation of the hematoma, followed by identification and elimination of the source of bleeding. A bacterial culture test is useful for prophylactic antibiotic therapy after surgery. Drainage to reduce the risk for complications should be carried out[17]. As for late hematoma, the procedure is the same, except for the histological examination of the capsule tissue; replacement of the implant is questionable.

CONCLUSIONS

Subacute hematoma after breast augmentation with implants is an extremely rare complication in esthetic surgery. The technique used for breast augmentation and mastopexy could be one of the reasons for bleeding. History of trauma or use of specific pharmaceuticals also could not be ruled out. However, most of the times the etiology of bleeding is unknown. This type of complication requires surgical treatment. We recommend that each case of late and subacute hematomas after breast augmentation with implants should be described and published for a scientific evaluation of this complication.

Conflict of interest: The authors have no conflicts of interest to declare.

Funding: No funding has been received for this report.

Ethical standard: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The patient gave her informed consent prior to her inclusion in this case report. Any details that might disclose the identity of the patient under study were excluded.

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Author's contribution: All authors participated in the research, and have reviewed and agree with the content of the article.

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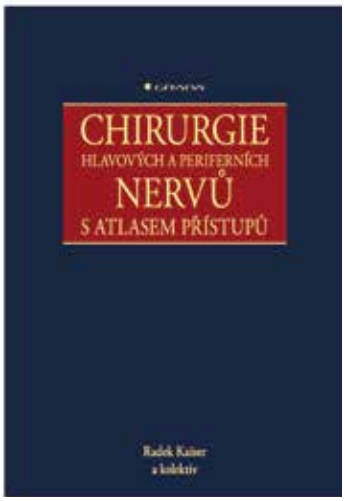
Chirurgie hlavových a periferních nervů s atlasem přístupů

Radek Kaiser a kolektiv



Předkládaná kniha Radka Kaisera a kolektivu je ucelenou a velmi podrobnou publikací o hlavových a periferních nervech, ojedinělou v našem písemnictví. Kniha vznikla na Neurochirurgické a neuroonkologické klinice 1. LF UK a ÚVN Praha za účasti 15 spoluautorů z několika pracovišť Ústřední vojenské nemocnice a Anatomického ústavu 1. LF UK. Popisuje současnou úroveň poznání z epidemiologie, etiopatogeneze, diagnostiky a chirurgické léčby nervových poranění, úžinových syndromů a nervových nádorů.
Základem publikace jsou neurochirurgické texty doplněné o teoretickou část popisující stručně stavbu a fyziologii nervu a patofyziologii nervového poranění. V rámci komplexnosti problematiky jsou doplněny kapitoly příbuzných odborností: neurology zpracovaná část o elektrofyziologii pre- i peroperační, anestezie, radiodiagnostické metody používané u poranění nervů a v neuroonkologii, patologem zpracovaná kapitola o nervových nádorech, obsáhlá stať o rehabilitaci při úžinových syndromech a po nervových úrazech, užitečná kapitola o ošetření sdružených poranění (cév, šlach a svalů) zpracovaná ortopedem a kapitola o diagnostice a léčbě bolestivých syndromů nervů. Problematika chirurgie hlavových nervů byla pro svou komplikovanost zpracována ve spolupráci s otorinolaryngologem. Text je obsáhlý, ale zároveň zůstává čtivým a klinicky dobře využitelným. Kapitoly jsou doplněny bohatou citací, a to nejen zahraniční literatury, ale i literatury české a samotných autorů.
Kniha obsahuje 16 kapitol na 232 stranách formátu A4 s celkem 137 barevnými fotografiemi a 72 obrázky. Anatomická schémata jsou převzata z Anatomie prof. Čiháka a vhodně publikaci doplňují. Obrazová dokumentace knihy je nadstandardní. Nejatraktivnější částí publikace je kapitola o chirurgických přístupech zpracovaná neurochirurgem a anatomem. Na 78 fotografiích detailně znázorňuje jednotlivé kroky při operacích všech klinicky důležitých hlavových a periferních nervů. Zobrazeny jsou i linie kožních řezů na reálném těle. Přístupy na čerstvých kadaverech působí velmi realisticky a jistě budou v praxi dobře využitelné.
Knihu jistě ocení nejen neurochirurgové a neurologové, ale i plastičtí chirurgové, chirurgové či ortopedi, a to nejen v běžné praxi, ale i jako zdroj informací při vědecké činnosti. Atlas přístupů se stává nezbytným pomocníkem při chirurgické revizi nervů, zejména při vzácnějších poraněních.

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AUTOLOGOUS FAT TRANSFER, BREAST LIPOMODELLING AND FAT TRANSFER TO THE FACE: CURRENT GOLD STANDARDS AND EMERGING NEW DATA

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SUMMARY

Autologous fat transfer techniques have experienced tremendous boom in the recent years. Plastic surgeons use these techniques to enhance both the features of the face and of the body. Over the years, controversies concerning fat harvesting, fat processing and fat injection came up. The authors of this review article describe their own experience with fat harvesting, processing and injection and show some of their own results. In addition, they discuss contemporary data from literature regarding the use and complications of fat grafting to the most common areas treated with fat grafting: breast and face.

KEYWORDS

Fat, microfat, nanofat, grafting, breast, lipomodelling, augmentation, reconstruction, facial, rejuvenation

INTRODUCTION

Autologous fat transfer is a surgical technique that is used to transfer adipose tissue in an injectable form from the donor area to the areas where adipose tissue is needed for tissue augmentation or for its regenerative properties. The method is often referred to as lipofilling, fat grafting, lipotransfer or autologous fat transplantation. In plastic and reconstructive breast surgery is the lipomodelling term probably the most accurate, because it reflects significant shaping potential of the technique on the breast. Whatever the method is called, however, the basic principles remain the same. Fat transfer may be used separately as a major surgical technique, or it may be an integral part of combined surgical procedures.

Fat transfer can be categorized according to the volume of transferred tissues to high- and low-volume fat grafting. **High-volume fat grafting** is performed primarily in order to supplement missing volume or to increase the size of the treated area. Typical examples of high volume fat grafting include breast lipomodelling in both reconstructive and aesthetic indications or correction of congenital chest deformities such as pectus excavatum [1-7].

In case of **low-volume fat grafting**, there is also the regenerative potential of fat utilized apart from its volume replenishment and contouring effects, especially in certain indications. Low-volume fat grafting is used in the treatment of radiation-damaged skin [8], in the treatment of scleroderma [9] or for the correction of the scars after burns [10,11]. It was also recognized as an optimal surgical strategy in the correction of the progressive hemifacial atrophy [12]. Finally, low-volume fat grafting is commonly used in aesthetic surgery for rejuvenation of the face [13-17], neck or hands [15]. The regenerative effect is expressed as an improvement in skin elasticity, texture and colour and as improvement in tissue vascularity.

Fat transfer consists of three consecutive steps: 1) fat harvesting, 2) fat processing, and 3) fat graft injection. All these steps may differ significantly depending on what is the main goal of the surgery and whether it is a high or low-volume fat grafting. Also the preference of the surgeon plays a role.

FAT HARVESTING

Adipose tissue is harvested by liposuction from subcutaneous fat deposits in the areas where fat is in excess. During fat harvesting, the main goal of harvested areas infiltration is not tissue tumescence but only tissue saturation with epinephrine. Therefore, lower volumes of the solution are used compared with tumescent liposuction

Fig. 1. Harvesting cannulas and syringes. From the right to the left: 1) 60 ml "Toomey" syringe – part of PureGraft™ set, 2) 30 ml luer-lock syringe – used in our department for breast lipomodelling, 3) 10 ml luer-lock syringe – used in our department for harvesting for facial fat grafting or for application during breast lipomodelling, 4) harvesting cannula with a diameter of 3.5 mm and length 17cm with 6 openings on the apex (PLA187 model, Pouret Medical, France) – used for breast lipomodelling, 5) Tulip harvesting cannula for microfat grafting, Sorensen type – reusable, and 6) single use harvesting cannula from "St'rim" set from the Thiebaud company used for microfat grafting

for cosmetic reasons. The amount of aqueous components in lipoaspirate is also rather a disadvantage because these aqueous components are to be eliminated during fat processing. Furthermore, when higher volume of infiltration solution is used, harvesting time is extended because of higher number of manipulations, which may also correspond with a higher consumption of material, e.g. sampling syringes. It is also recommended to use infiltration solution without local anaesthetics since they have been shown to have toxic effects on adipocytes and preadipocytes [18,19]. For all these reasons, if the whole surgery is scheduled under general anaesthesia, we use low-volume infiltration with normal saline and higher concentration of epinephrine (2:1,000,000) and we recommend infiltration of harvesting areas by local anaesthetics when harvesting is finished.

Liposuction is performed most commonly manually using "luer-lock" syringes to connect the cannula or "Toomey" syringes with conical tip type of cannula. Vacuum is created by continuous movements of the syringe plunger or by using a holder for the plunger. Another option is usage of lipoaspirate collectors where output is connected to the aspirator and input to the cannula. The collectors are used more often, particularly when high volume fat grafting is carried out more frequently in the department. The advantage of using the collector is the fact that the vacuum can be defined more precisely. However, there is no study showing that higher values of negative pressure would significantly affect the viability of harvested adipose tissue [20-22].

Harvesting technique significantly affects the quality of fat graft. Cannulas differ in the number, size and spatial arrangement of openings in the tip and also in diameter and length. Cannulas for low-volume fat grafting are thinner and they usually have multiple openings with a diameter below 1 mm (Figure 1). Tonnard et al. have demonstrated significant differences in adipose tissue viability depending on the size of the openings in the tip and on the number of passages through the "luer-lock" syringes. Adipose tissue viability was significantly higher after fat harvesting using 3mm cannulas with three openings of 2x7mm in the tip then after using 3mm cannulas with multiple circular sharp holes

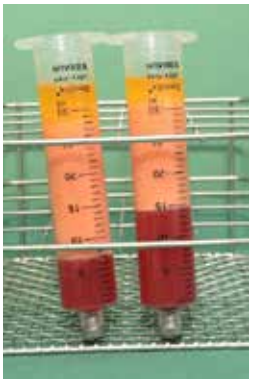

Fig. 2. Fat processing by centrifugation in 30-ml syringes for high-volume fat grafting

of 1-mm diameter in the tip (microfat grafting technique). Furthermore, their study has shown that adipose tissue viability is further decreased by repeated passages between the syringes via "luer lock" connector (nanofat grafting technique). On the contrary, usage of a cannula with small openings in the tip or repeated passages through "luer lock" connector had no negative impact on the concentration and characteristics of stem cells in harvested adipose tissue that are associated with regenerative effect after fat grafting [23].

Liposuction system, which allows infiltration of harvesting area with tumescent solution by water jet and simultaneous harvest of adipose tissue has been recently developed ("water jet assisted liposuction"). An essential part of this system is a two-way cannula with an opening for the water jet in the tip with openings for lipoaspirate suction on its sides.

FAT PROCESSING

Harvested adipose tissue (lipoaspirate) is a mixture of adipose tissue fragments, lipid droplets, cellular debris, infiltration solution and blood. The quality and ratio of the individual lipoaspirate components is defined by harvesting technique. The aim of lipoaspirate processing is to obtain a purified cell mixture, which has a minimal extent of volume absorption and/or maximal regenerative effect.

For the surgeon, a large number of technical options exist for fat processing. The most commonly used techniques for lipoaspirate processing in clinical practice include 1) decantation; 2) centrifugation with different speeds, diameters, volumes, and tube shapes; and 3) filtering through a simple membrane (mesh) or filtering through a membrane combined with washing in more sophisticated devices such as PureGraft™.

Decantation is the oldest method that is still used by some surgeons because it is simple and cheap, although time consuming. Lipoaspirate processing is based on decantation also in recent lipoaspirate collectors that seem to be more effective as they are directly connected to the aspirator and to the harvesting cannula.

Centrifugation is the most commonly used technique for processing of lipoaspirate. It was popularized by Coleman, who described in detail the processing techniques using 3-minute centrifugation with a relative centrifugal force of 1286 g. Lipoaspirate is divided by centrifugation into four clearly distinguished layers: 1) the upper oily layer, 2) the middle adipose layer, representing most of the adipose tissue, and 3) the lower aqueous layer, consisting mainly of tumescent solution, and 4) the pellet at the bottom of each tube (Figure 2). Centrifugation is carried out usually directly in the harvesting syringes with luer lock connector. The effect of centrifugation on the biological properties of adipose tissue has been described in many studies[13,24-29]. In our department, we centrifuge lipoaspirate at a relative centrifugal force of 1,200 g directly in the harvesting 10-ml syringes for low-volume fat grafting and in 30-ml syringes for high-volume fat grafting. We believe that usage of 30ml syringes reduces significantly the number of manipulations and thus operating time.

The third basic principle of lipospirate processing is **filtration through a membrane**. Perhaps the simplest option is filtration and washing with saline solution through a filter membrane positioned on top of the surgical bowl [30]. The disadvantages are obvious, the tissue is prepared on open air and the number of manipulations is relatively high. Nevertheless, due to its simplicity and cost it is still used, especially for low-volume fat grafting procedures. More sophisticated devices that are based on the filtration principle are also available. These devices can be designed like canisters connected directly to the aspirator and harvesting cannulas. The outlet portion for the liquid components of lipoaspirate can be constructed as a single outlet at the base of the container, or it can be connected also with the aspirator. Another membrane-based tissue filtration system is PureGraft™, which is designed for manual sampling liposuction syringes with "Toomey" tip. The device consists of a plastic bag, which is divided inside by double filtration membrane into the inlet and outlet parts. Valves for the lipoaspirate installation orifice together with input for Ringer solution into the inlet part; outlet part is connected to the waste plastic bag (Figure 3). Advantages of these more sophisticated devices may be lower number of manual manipulations during fat preparation and the design as a closed system. On the other hand, their disadvantage is that it can eliminate undefined substances, such as cytokines and/or growth factors, that may augment the regenerative effect of lipoaspirate application [31].

Streit et al. recently comprehensively compared these preparation techniques in vitro. Morphology of each prepa-

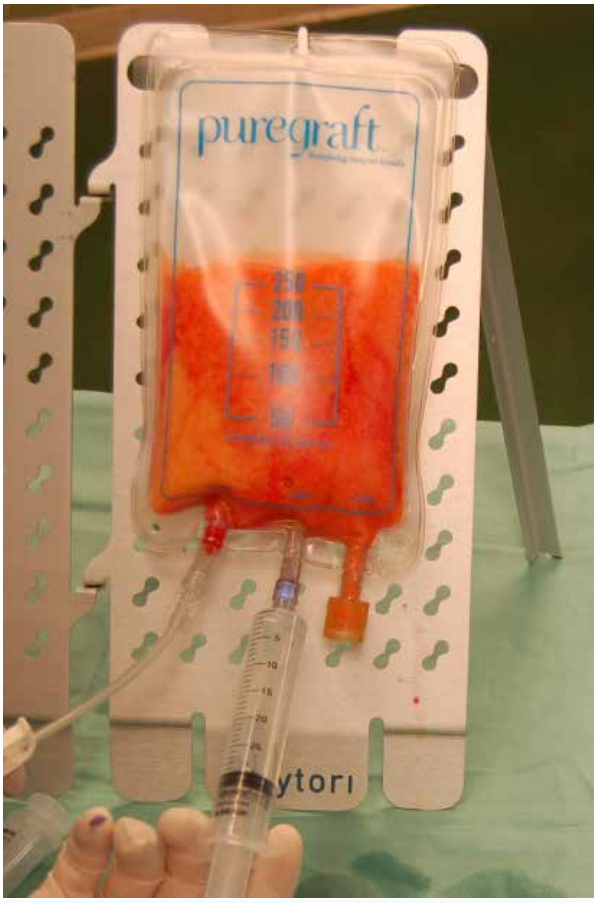

Fig. 3. Fat processing by washing and filtration through a membrane using PureGraft™ devices

Fig. 4. Application cannulas. On the left, 2mm cannulas with a length of 20 and 13 cm (PLA188 and 189 models, Pouret Medical, France). In the centre, 1.5mm cannulas with a blunt tip (Coleman™ Style 1, Mentor, USA) and "V" shaped tip to release scars ("V" Dissector Cannulae, Mentor, USA). These cannulas and similar styles are suitable for lipomodelling of the breast. On the right is an example of cannulas for fat grafting to the face, diameter 0.9 and 0.7 ml (Tulip, USA)

ration was assessed by electron microscopy and overall cell viability by live/dead assay. Number of adipose derived stem cells (ASC) was determined and their stem cell character was assessed by the presence of cell surface molecules and by their capacity to differentiate into adipogenic and osteogenic lineages. They have demonstrated that 1) decantation is a very gentle technique that best preserves components of the extracellular matrix, but the product of decantation is to some extent contaminated with oil droplets and residues of disrupted adipocyte membranes; 2) centrifugation isolated the highest concentration of ASC from the upper two-thirds of the adipose layer of centrifuged fat (low-density fraction). Centrifuged fat was almost completely devoid of contaminating oil droplets and debris, and it retained considerable amounts of the fibrillar components of the extracellular matrix; and 3) centrifuged fat compared with membrane-processed fat contained about the same concentration of ASC with similar viability. Although filtration also effectively removed oil droplets and cell debris, membrane-processed fat again retained a substantial part of the fibrillar components of the extracellular matrix. Finally, the watery component was minimal in membrane-processed fat [29]. Because the differences were not dramatic, authors concluded that centrifugation and membrane-based tissue filtration are equivalent techniques and superior to decantation in clinical practice.

In the selection of processing technique for clinical practice, another criteria such as practicability for the individual surgical settings (close vs. open system, number of manipulations, price, required time, etc.) remain crucial for the surgeon [31].

Cell assisted lipotransfer is used to increase engraftment and decrease liponecrosis in the recipient tissue. This technique is based on enrichment of fat graft with stem cells or stromal vascular fraction cells [32]. Core factor affecting absorption is cell apoptosis due to inflammatory condition after transplantation and the lack of angiogenesis. Stem cells may improve fat survival in three ways - they release growth factors and help the surrounding tissue to resist hypoxia and ischemia; they differentiate into adipocytes and regenerate the adipose tissue and they promote vasculogenesis. However, there is absolutely no statistical evidence that proves this assumption [33-36].

FAT TRANSFER

Purified adipose tissue is usually injected with syringes (10-ml syringes for high-volume fat grafting, 1-ml syringes for low-volume fat grafting) and special application cannulas (Figure 4). The cannula is introduced through multiple entry points created by a needle or scalpel in order to achieve a honeycomb structure of multiple microtunnels. Fat is injected in small quantities in the form of fine cylinders resembling spaghetti. Each microtunnel must be surrounded by well vascularized tissue (Figure 5). Transfer is done from a deep to a superficial plane. Good spatial visualization is necessary to form a sort of three-dimensional honeycomb, to avoid creating areas of fatty pools, which would lead to fat necrosis [4].

During high-volume fat grafting, it is necessary to know how to overcorrect the quantity of fat, if allowed by the recipient tissues, as absorption of about 30-40% volume may be expected. When the recipient tissues are saturated and cannot accept more fat, it is not advisable to continue, because of the risk to create areas of fat necrosis. It is better to plan an additional session than disregard saturation of the tissues. Incisions are sutured using very fine suture material.

Technique of multiple percutaneous fasciotomies performed with 17-gauge trocar or needle is one of the advancements of the lipomodelling technique. This technique is also called three dimensional ligamentous band release or "Rigottomy". It is powerful technique for scar releasing, it allows us to move down the submammary fold and to sculpture bottom part of the breast if required (in tuberous breast) [4,37].

External breast tissue expander (BRAVA®) was introduced as a nonsurgical alternative to breast augmentation. The system consists of two domes with soft silicone edge and it is worn as a bra. Attached pump creates negative pressure within domes and consequently acts as an expander [38,39]. Action of negative pressure leads to 1) the enlargement of breast tissue and its vascularity, and to expansion of skin, which is advantageous especially in breast reconstruction.

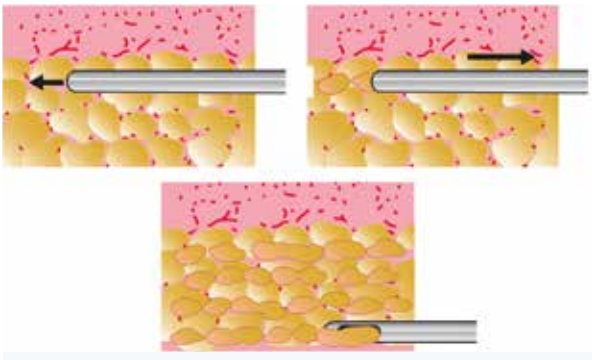

Fig. 5. Principle of fat transfer into multiple layers of recipient subcutaneous tissue

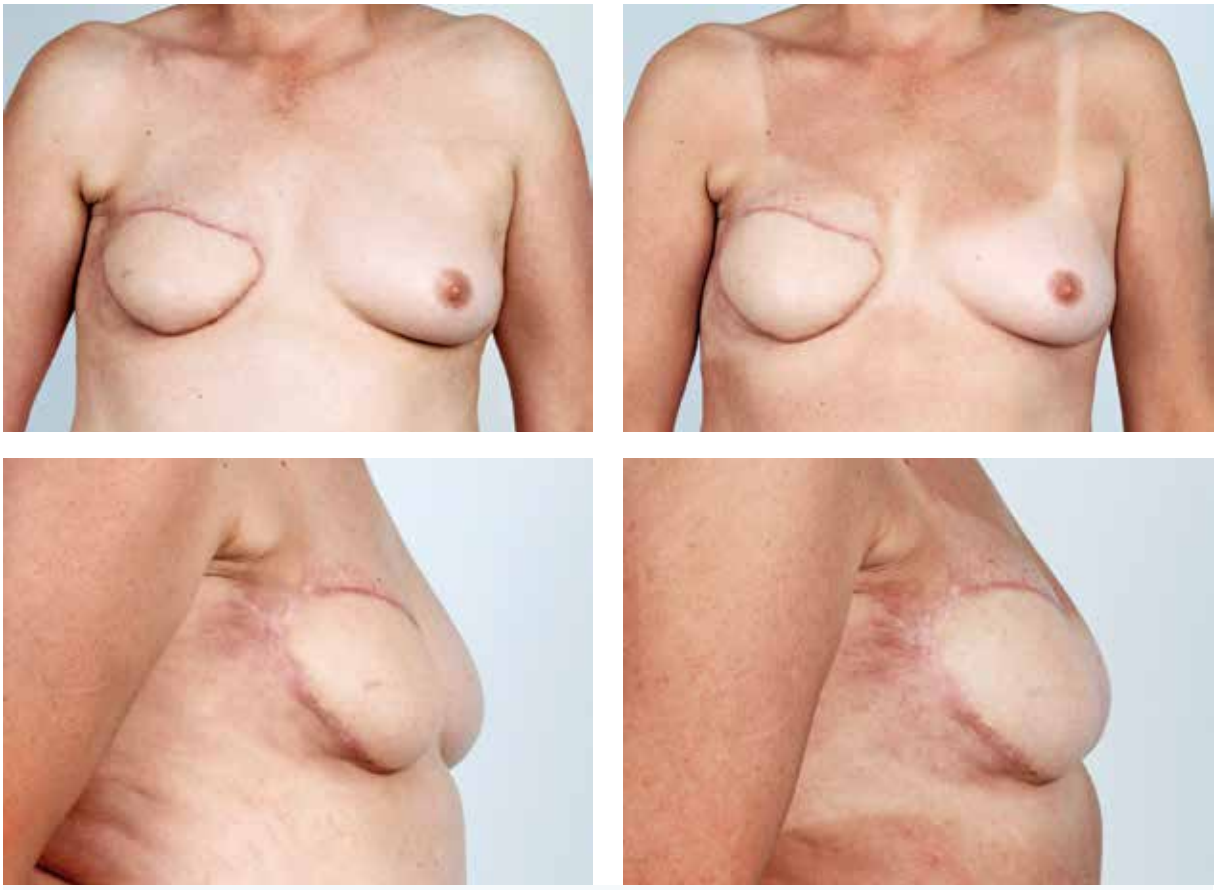

Fig. 6. A 51-year-old patient with the history of secondary breast reconstruction using abdominal flap before and 5 months after one lipomodelling session with 180 ml of fat

This results in enlarged tissue bed for fat injection. The larger is the preoperative expansion, the more volume we are able to inject. We recommend wearing BRAVA 3 weeks/12 hours per day before fat grafting. It is advisable to over-expand the breast in order to gain sufficient skin envelope for fat application. With this system we can perform mega volume fat grafting, which means we can safely achieve volumes of around 300 ml per breast. While wearing BRAVA postoperatively we decrease pressure of surrounding tissue on the graft, which does not act as an internal expander anymore and we achieve better graft nutrition. The patients wear BRAVA for 12 hours per day postoperatively, for at least 4 weeks. Patient compliance is essential since it is necessary to wear the system pre- and postoperatively for a relatively long time.

BREAST LIPOMODELLING

Breast reconstruction by autologous fat transfer

In breast reconstruction, fat transfer may be used separately as a major surgical technique, or it may be an integral part of combined surgical procedures.

Breast reconstruction by repeated lipomodelling

Capacity of the donor site to accept fat graft is closely related to the initial volume of well-vascularized donor tissues. In secondary breast reconstruction, it is essential to reconstruct or expand missing skin, which is crucial in selection of reconstructive technique, especially in an irradiated patient. Furthermore, volume absorption after fat grafting is very high when applied into the irradiated chest wall. Thus, we recommend this reconstructive technique just for non-irradiated patients, despite the availability of BRAVA enlargement system. On the contrary, breast reconstruction by repeated lipomodelling is very promising in primary reconstruction after prophylactic mastectomy, or in hypoplastic breast malformations (e.g. Poland's syndrome). Very important aspect of the consultation is to make the patient understand about the maximal possible breast size (cup size approximately B+) and about the need of higher number of lipomodelling sessions (usually 3-5)[4].

Lipomodelling for the correction of sequelae of conservative treatment

Breast reconstruction after breast conserving therapy is problematic. Two factors must be considered. The first is the uneven breast shape resulting from partial mastectomy. The second is the preexisting irradiation of the breast [40]. Therefore, breast reconstruction using fat grafting is an attractive tool for treatment of this deformity with possible local filling of the defect as well as regenerative properties of the graft [41].

We perform this procedure under general anesthesia. The injection is performed very slowly with a fan-shaped

technique during the withdrawal of the cannula. We attempted (as much as possible) to prevent accumulation of the fatgraft and overfilling of the tissue to prevent ischemia, necrosis, colliquation and calcification, which is more likely in irradiated tissue.

Fat grafting to breast after breast cancer has been questioned regarding higher risk of cancer recurrence. This possible risk would be higher in patients after breast conserving treatment. However, this assumption has not been confirmed in clinical studies yet [42].

Lipomodelling as the complement of autologous breast reconstructions

The abdominal free flaps and the latissimus dorsi flap are the two most common autologous breast reconstruction techniques today.

The abdominal free flaps are often considered to be the gold standard for autologous breast reconstruction. Defects may however also develop after their use, in particular asymmetry of volume, lack of projection, defect in the décolleté or possibly partial flap loss. In these cases, we carry out intrapectoral lipomodelling and lipomodelling of the flap (Figure 6).

The autologous latissimus dorsi flap is an ideal tissue to receive fat transfer as it is very well-vascularized and very large quantities of fat can be injected into it. Volume of 200-450 ml per breast and per session may be injected with very good results [1,4,43]. The autologous latissimus dorsi flap can now be considered as an auxiliary method that prepares the breast recipient site for future lipomodelling. We recommend performing lipomodelling quite early (after 3-4 months), before muscle atrophy is maximal, in order to take the advantage of the volume effect, which allows the area to accept sufficient amount of fat.

Breast augmentation by autologous fat transfer

There has been a boom in the demand for autologous fat breast augmentation in recent years. As our experience with this procedure extends, indications and limitations for this procedure clarify. Today, we know that autologous tissue transfer to the breast cannot replace breast augmentation using silicone implants [44]. Indications for fat grafting are different then for breast augmentation with silicone implants. Also, contrary to fat grafting to the face, we are talking about high-volume, or sometimes "mega-volume fat grafting", since we inject volumes of around 250-300 ml. This method is suitable for patients, who require rather smaller enlargement of the breast (at about one cup size), with sufficient breast skin envelope and sufficient adiposity in the lower part of the body. Breast augmentation by fat transfer is performed in sessions if more significant breast enlargement is requested by the patient.

First modern attempts for fat grafting to the breast in 1980' launched a wave of negative attitude on the account of fear of calcifications, which could impair breast cancer detection. Subsequently, this method was banned for several upcoming years without any scientific data.

Radiologic follow-up of breasts treated with fat grafting is not complicated and should not prevent plastic surgeons from offering this procedure [45,46]. Far more common are calcifications after different kinds of breast operations – for example reduction mammaplasty [47]. Calcification after fat grafting, in case of the use of correct technique, are localized in different areas and reveal different radiological image then those in breast cancer. The best approach is to perform radiological examination ahead of the procedure to find out existing lesions. We advise performing follow-up examination one year after the procedure.

In addition, concerns about the oncologic safety remain a controversial topic among plastic surgeons and other physicians. In vitro studies have repeatedly shown an increased activation of breast cancer cells by adipose derived stem cells; however, clinical research, although limited, continually fails to show an increase in breast cancer recurrence after breast fat grafting not only in cosmetic breast augmentation patients but also in breast cancer patients [48-52].

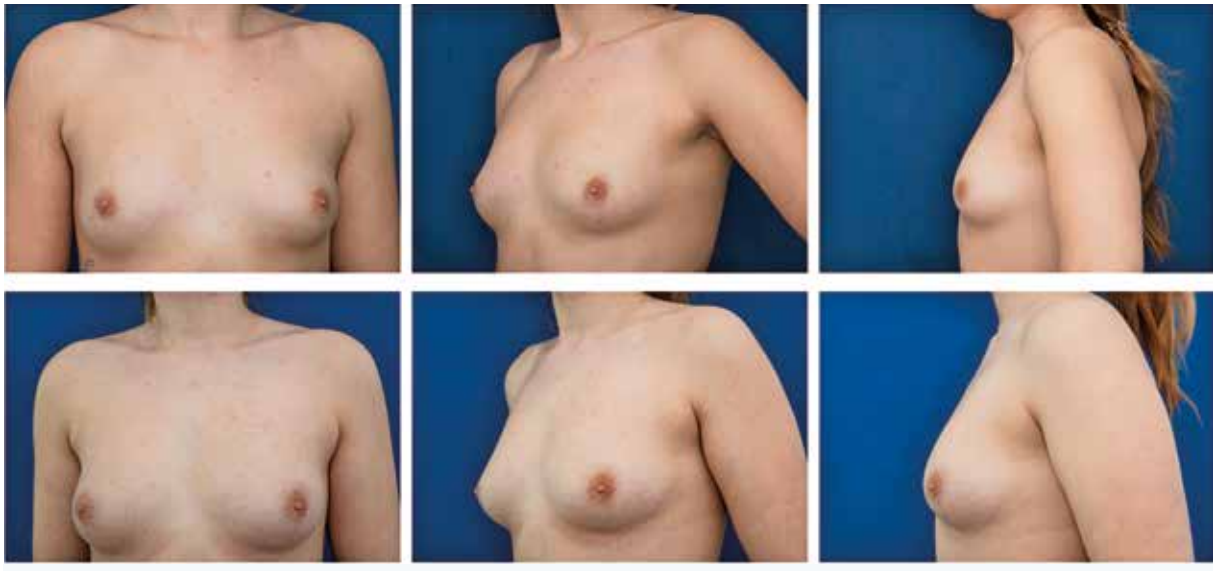

Fig. 7. Patient before and 6 months after one session of autologous fat breast augmentation

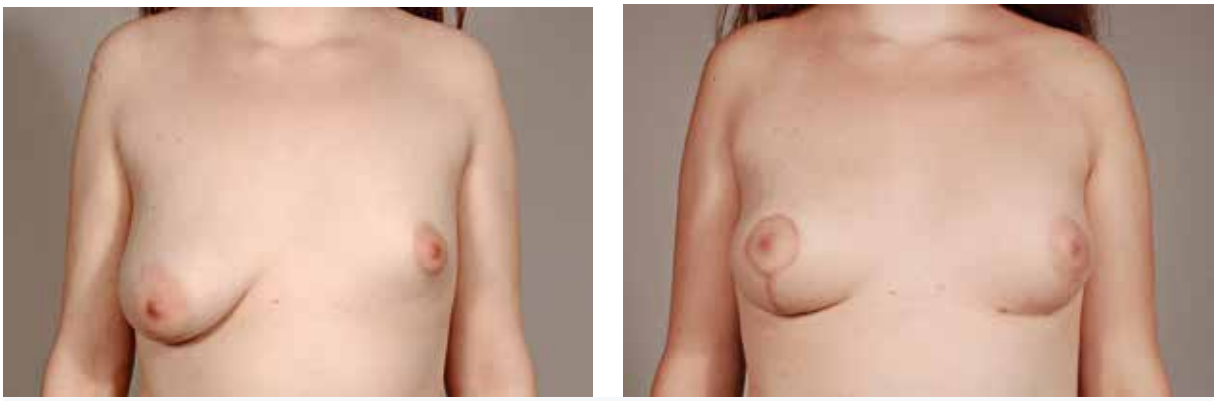

Fig. 8. A 17-year-old patient with hypoplastic left breast and ptotic right breast before and after 2 sessions of lipomodelling on the left and contralateral vertical mastopexy with augmentation by fat grafting in décolleté area - 6 months follow-up

We usually perform this procedure under general anaesthesia and we use methods described above for graft harvesting and processing. We infiltrate the breast from multiple entry points circularly around the breast base. We can infiltrate subcutaneous space, subglandular space and also the pectoral muscle. In order to ensure sufficient blood flow to the entire graft, we should be careful not to overfill the breast tissue. The maximal volume of graft is approximately 200–250 ml for B size breast, 300–350 ml for C size breast etc. We risk graft ischemia, absorption, necrosis and calcification with too large graft volumes. Based on authors' experience, it is essential to overfill the size of the smaller breast in comparison with the contralateral side in cases of breast asymmetry because of the expected asymmetrical fat absorption. Relative volume resorption remains the same (30–40%), but the final volume absorption is different when asymmetrical volumes of processed fat is applied.

Preoperatively we educate the patient about the graft volume we plan to inject to the breast and about the possibility of 30–40% absorption. We do not use any compressive garment postoperatively, since it could impair blood supply to the graft. The patient should postoperatively keep stable weight, in order to prevent lowering of the volume of the augmented breast (Figure 7, 8).

Simultaneous Breast Implant Exchange with Fat (SIEF)

Simultaneous Breast Implant Exchange with Fat is suitable for patients asking for breast implant removal while maintaining the volume [53,54]. The procedure can be performed in two ways – fat is injected before or after implant removal. We inject fat into all possible planes, into subcutaneous and subpectoral after breast reconstruction and also into subglandular space after breast augmentation. We take care not to inject into the capsular space. In the case of implant removal before injection, we use finger guidance in this space to prevent penetration of capsule by the cannula. We also recommend using blunt cannula for injection.

Composite breast augmentation

As mentioned above, breast enlargement by fat grafting is limited and silicone implant augmentation continues to be a gold standard. However, we can use benefits of both techniques to achieve the best results – the volume created by the silicone implant, covered by the fat graft. With this technique, we cover the visible edges of the implants in thinner women. Fat can be injected before or after insertion of the implant. We prefer injection with implant already in place to achieve better overview of the final result. For this reason, we need to use blunt cannulas, which decrease the risk of implant penetration. Motiva (Establishment Labs) recently created a cannula with special tip intended to use for composite procedures. Fat is injected especially to the décolleté region and according to specific needs to any other regions of the breast.

AUTOLOGOUS FAT TRANSFER TO THE FACE

Autologous fat transfer to the face has become a common technique to treat volume and contour abnormalities in aesthetic and reconstructive facial plastic surgery [55]. It has also been widely used for the management of facial aging signs [16,56].

Signs of aging with regards to fat grafting

Aging process affects all facial structures. The process includes changes in the skin and its appendages, subcutaneous tissues, and bony skeleton.

Skin and appendages are influenced by intrinsic (normal aging) and extrinsic (photoaging, smoking) factors and these are manifested by the ***changes of skin texture*** (wrinkling, atrophy and increased fragility, changes of colour, etc.).

Subcutaneous tissue includes fat compartments and the SMAS system with interconnections to skin that are essential for transfer of facial expression triggered by the facial muscles to the skin surface. Aging process in subcutaneous tissue is associated with atrophy of volume (*deflation*), migration of fat compartments and increased soft tissue laxity with ptosis causing ***changes of contour***.

The changes in subcutaneous tissues are further enhanced by absorption of bony skeleton in the upper face and midface such as the orbital margins, prejowl mandible, pyriform aperture and nasal spine causing reduction of support for soft tissues.

Fat grafting may be used to address all of these changes in a certain extent, i.e. it can supplement volume and add support to tissues, replace missing bony structures and correct skin texture changes.

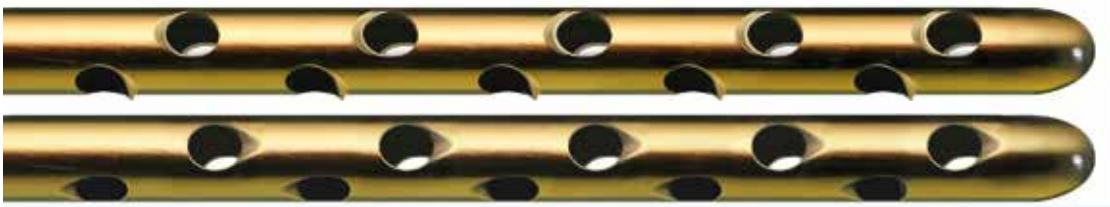

Fig. 9. Examples of harvesters for facial fat grafting (Tonnard, Sorensen style)

Fig. 10. Examples of injectors for facial fat grafting. These may be curved or straight as per surgeon's preference

Technique for facial fat grafting

The technique of facial fat grafting differs from standard techniques used elsewhere in the body. It is necessary to use finer instruments to harvest smaller fat particles to be injected to the face. This prevents creation of bulges and irregularities that could develop after the standard fat grafting technique. Fat grafting to the face is referred to as *microfat grafting* or also low-volume fat grafting due to this difference.

Examples of such fine instruments include e.g. various Tulip cannulas with a small diameter for harvesting and various small diameter injectors for application of fat. (Figure 9, 10).

There are various application methods of microfat grafting and they include application of fat to the deep to act as a deep filler, superficially underneath the skin and intradermally into the dermis of the skin to treat fine and deep wrinkles and also a special form of fat for regenerative purposes. These various types provide different effects on target tissue.

Deep microfat grafting

Fat injected as a deep filler is used to supplement missing volume and for facial contouring. There are various areas in the face that loose volume with age and need filling (Figure 11). These include the temples, eyebrows and upper eyelids, infraorbital area, tear trough, malar area, nasolabial folds, lips, and the area of the Marionette lines.

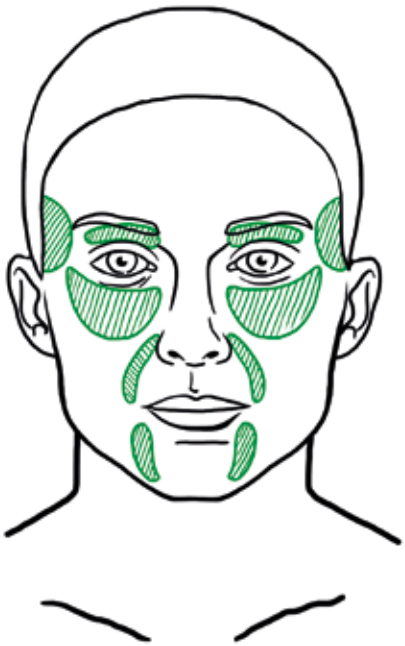

Fig. 11. Areas that usually need deep filling with fat during facial fat grafting

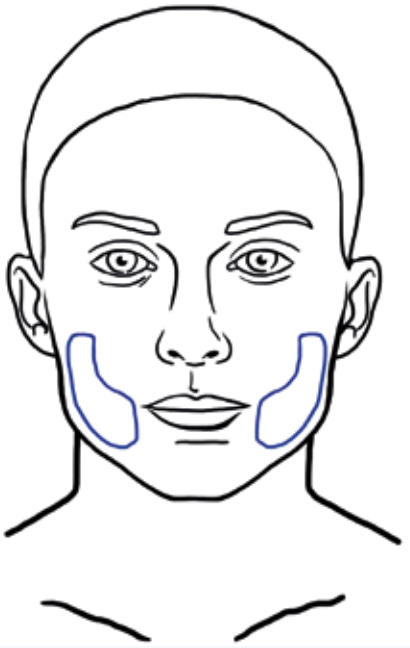

Fig. 12. Example of area that may benefit from superficial microfat grafting

Filling effect of fat is also utilized in reconstructive procedures, such as augmentation rhinoplasty [57] to augment the dorsum of the nose or for correction of mandibular or maxillary hypoplasia that have traditionally been treated with orthognathic surgery [49,57-60].

Superficial fat grafting

Fat is injected to the superficial layer just underneath the skin. This technique addresses the aging induced atrophy that is characterized by disappearance of a continuous layer of fat underneath the skin. There are areas with more pronounced deflation to be treated with deep filling, but superficial fat grafting is beneficial in areas where fine wrinkling occurs that cannot be filled intradermally and there is no deep space to fill (Figure 12). This technique is more exactly referred to as *superficial microfat grafting* [61]. Superficially injected fat has also regenerative potential on the skin. Study performed by Charles-de-Sá et al. demonstrated that treatment with fat and stromal vascular or expanded mesenchymal stem cells modified the pattern of the dermis, representing a skin rejuvenation effect. Effects of treatment are visible in the epidermis also, even though the injection takes place in the subcutaneous region [17].

Various modifications exist, such as superficial enhanced fluid fat injection (SEFFI) where fat is combined with platelet rich plasma for enhancement of its effect [62,63].

Intradermal fat grafting

This technique was described by Zeltzer et. al. and popularized by Tonnard and Verpaele as SNIF (Sharp Needle Intradermal Fat grafting). Simple microfat is injected with a needle into the skin, into deep rhytides (Figure 13). This has an effect of a natural filler and smoothes wrinkles very effectively [30].

Nanofat and regenerative potential of fat

The therapeutic benefit of autologous fat is partly ascribed to the presence of precursors of adipose derived stem cells (ASCs), which are progenitor cells that reside in the stromal vascular fraction (SVF) of adipose tissue. ASCs are able to differentiate into various cell lineages and seem to be suitable for repair of damaged tissue in organs and aged skin [64]. In cosmetic facial surgery, ASCs are reported to be beneficial for skin rejuvenation [65]. Special fat processing techniques, which destroy mature adipose cells are able to prepare an injectable product, which contains a high concentration of ASCs and no viable mature adipose cells [64]. The final injectable product is injected directly into the skin with a fine needle. Tonnard et. al. described the nanofat grafting technique, which is indicated for general skin rejuvenation, treatment of dark circles under the eyes, post-acne scaring, striae, etc. [66]. Typical areas for nanofat grafting are show in Figure 14.

Survival of fat in the face

Survival of fat in the face varies and is influenced mainly by the mobility of the target area. Mobile areas such as glabella or lips are associated with lower retention of fat compared with less mobile areas, such as malar and lateral cheek [55]. Stabilization of the graft may be considered after 4 months from the surgery.

Complications of facial fat grafting

Complications following fat grafting to the face are rare. The most common complications include irregularities in the donor area after fat harvesting, and asymmetry, irregularities, bulges, under-filling and overfilling in the target area. Rare complication is fat embolism to the ophthalmic artery and cerebral arteries with subsequent blindness and

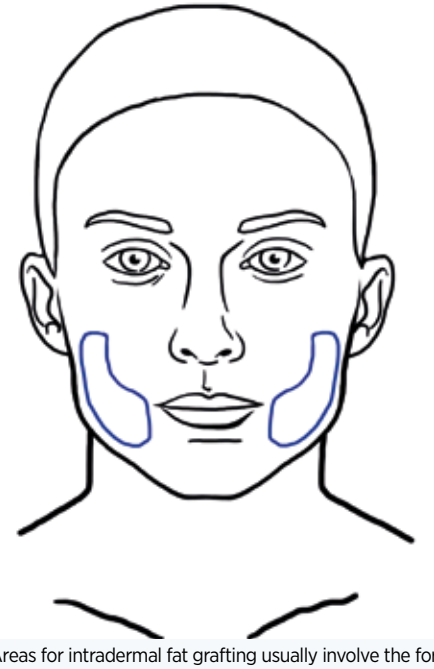

Fig. 13. Areas for intradermal fat grafting usually involve the forehead, glabellar rhytides, nasolabial fold and perioral rhytides. SNIF technique can also be used for improvement of lip and philtrum contou

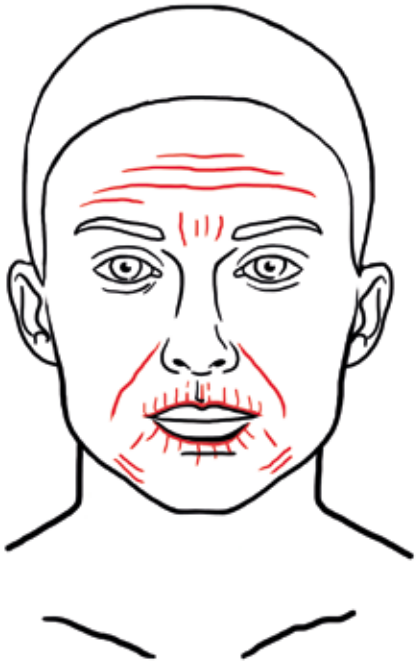

Fig. 14. Red dotted areas represent examples of areas typically treated with nanofat for regenerative purposes

Fig. 15. A case of a 45-year-old female patient with profound deflation of the face seeking rejuvenation. Originally she requested filler injection but was offered facial fat grafting. The figure shows pre- and postoperative photographs. There was a total of 24 ml of microfat injected and included deep filling of malar, tear trough area and nasolabial folds, superficial fat grafting to the cheeks. Note mainly the change of contour of the malar area on the 45° view

cerebrovascular accident that have been reported after fat injection mainly to the glabellar area [67,68].

Postoperative course and management

The postoperative course after facial fat grafting is associated with very low morbidity. There are signs and symptoms from the donor area, which is the most disturbing for the patient and it is similar to smaller liposuction. In the application area, there is usually swelling and bruising that subsides quickly after surgery, usually within 1–2 weeks. Pain is not a common symptom after facial fat grafting. In the postoperative management we usually do not use any special garments for the donor area, as the harvested volume is very low. It is advisable to provide antibiotic cover to the patient perioperatively.

Combination of facial fat grafting with other facial rejuvenation techniques

It is convenient to combine facial fat grafting with other facial plastic surgery techniques such as face-lifting, upper and lower blepharoplasty, chemical or laser resurfacing, etc. The effects multiply and the final cosmetic result of the combined surgery is potentiated [69,70].

Complex facial fat grafting

Complex facial fat grafting is a combination of several or all of the fat grafting techniques to treat various problems that are present in the face in the same time. These may be performed in one session. There is usually enough fat to be harvested to perform complex treatment, i.e. deep filling, superficial microfat grafting, intradermal fat grafting and possibly take the advantage of regenerative capacity of fat on facial skin (Figure 15). This is a great difference compared with artificial fillers based on hyaluronic acid, which are usually very costly, the quantity is limited mainly by price and it lacks any regenerative potential. The usual quantity of fat that is needed for complex fat grafting is 20–30 ml of processed fat or more.

CONCLUSION

Autologous fat transfer techniques have experienced tremendous boom in the recent years. High-volume fat grafting is performed primarily in order to supplement missing volume, low-volume fat grafting has also a regenerative potential apart from its volume replenishment and contouring effects, especially in certain indications.

Lipomodelling is a major development in plastic, reconstructive and aesthetic surgery of the breast, and we consider it as one of the major advances of the last 20 years. The technique is now well codified and the complication rate is very low. Because of the very good results obtained and the excellent acceptance of the technique by the patients, lipomodelling has considerably modified our indications in plastic, reconstructive and aesthetic surgery of the breast.

Facial fat grafting is an effective and rather mini-invasive procedure that is able to provide very interesting effects in the treatment of overall facial aging signs. It has a filling as well as regenerative potential and may be combined with other facial procedures to achieve enhanced results. It may be performed under local anaesthesia with mild sedation and the postoperative course is very smooth.

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ČESKÉ/SLOVENSKÉ SOUHRNY

ACTA CHIRURGIAE PLASTICAE, 59, 2, pp. 109–111

KOMPLIKÁCIE POÚRAZOVÝCH HEMATÓMOV DOLNÝCH KONČATÍN U WARFARINIZOVANÝCH PACIENTOV

Bukovčan P., Koller J.

Úvod. Cieľom práce je stanoviť počet warfarinizovaných pacientov liečených a hospitalizovaných na našom klinickom pracovisku kvôli komplikáciám hematómov, ktoré sa rozvinuli po úrazoch, analýza zistených údajov, použité metódy riešenia a tiež výsledky liečby.

Pacienti a metódy: Do retrospektívnej klinickej štúdie sme zaradili všetkých dlhodobo warfarinizovaných pacientov, ktorí boli v období od januára 2006 do decembra 2016 prijatí na naše pracovisko s poúrazovými hematómami alebo stratami kože v plnej hrúbke.

Výsledky: Do štúdie bolo zaradených 9 mužov a 2 ženy. Všetky úrazy sa stali doma. Okrem jednej ženy primárne hospitalizovanej na našom pracovisku boli všetci pacienti primárne hospitalizovaní v rajónnych nemocničných zariadeniach s priemernou dĺžkou hospitalizácie 32,6 dňa. U všetkých pacientov preložených na naše pracovisko bolo potrebné vykonať chirurgický zákrok. Priemerný povrch rán lokalizovaných u všetkých pacientov na dolnej končatine bol 136,3 cm^2 (rozmedzie 45 až 525 cm^2). Priemerná dĺžka hospitalizácie bola 15 dní.

Diskusia: Získané dáta boli v diskusii porovnané s výsledkami podobných štúdií.

Záver: Klinici, lekári prvého kontaktu a tiež warfarinizovaní pacienti by mali byť oboznámení s rizikom vzniku poúrazových hematómov. Dôsledky aj menšej traumy v oblasti dolnej končatiny môžu byť závažné a môžu viesť k vzniku chronickej rany s nutnosťou komplexného riešenia.

CHIRURGICKÁ KOREKCE HYPERTROFIE LABIA MINORA, OSOBNÍ TECHNIKA

Di Lorenzo S., Corradino B., Cillino M., Hubova M., Cordova A.

Východisko. Hypertrofie labia minora je kongenitální nebo získaný stav, kdy labia minora (nebo vzácněji pouze jedno labium) protrudují za okraj labia majora. Autoři prezentují chirurgickou techniku volumetrické redukce hypertrofických labia minora spojenou s lipofilingem labia majora.

Metody. Mezi lety 2005 a 2014 podstoupilo 27 pacientek chirurgickou redukci labia minora popsanou Altierem a Rouzierem. Indikace chirurgické léčby byly různé: interference s pohlavním stykem, špatná hygiena, potíže při nošení těsných kalhot, potíže při sportovních aktivitách, jako je jízda na kole, estetické potíže. Chirurgická resekce byla spojena s injekcí tukového štěpu do labia majora za účelem ochrany a krytí labia minora. Průměrná doba sledování byla 1 rok.

Výsledky. Labia majora, po zvýšení objemu a tuhosti, chrání a zakrývají labia minora, které jsou lehce hypertrofické nebo chirurgicky redukované. Všechny pacientky hlásily zlepšení pohodlí, estetického vzhledu při nošení těsného oblečení a zlepšení své sexuality. V jednom případě jsme zaznamenali „recidivu“ se zvětšením rozměrů labia minora do šířky, i když byly nadále menší, než byla situace před operací, ale byly větší než těsně po operaci.

Závěry. Snížení hypertrofie labia minora konzervativními technikami umožňuje dosažení excelentních výsledků ve smyslu estetiky a funkce. Jednoduchý lipofiling labia majora umožňuje zachování a ochranu labia minora prostřednictvím volumetrického zvětšení labia majora.

STEH PROTI FIBRINOVÉMU LEPIDLU PŘI MIKRONEURÁLNÍ ANASTOMÓZE FEMORÁLNÍHO NERVU U MODELU POTKANA SPRAGUE DEWLY. KOMPARATIVNÍ EXPERIMENTÁLNÍ HODNOCENÍ KLINICKÝCH, HISTOLOGICKÝCH A STATISTICKÝCH CHARAKTERISTIK

Adel M., Elgamal D.A., Bakry R., Abdelkader M., Elshazly M., Kamel A.

Úvod. Poranění periferních nervů je často zjištěný klinický problém, který způsobuje funkční ztráty z dlouhodobého hlediska. I když byla u poranění periferních nervů zavedena do klinické praxe mikrochirurgická technika rekonstrukce, neuspokojivé výsledky týkající se funkčního zotavení v cílovém orgánu způsobují vyšší zájem o studie týkající se poranění nervů a biologii zotavení u poranění nervů.

Materiál a metody. Ischiadický nerv u sedmdesáti dospělých potkanů Sprague Dewly byl přerušen a byla provedena primární anastomóza. Potkani byli rozděleni do tří skupin. V kontrolní skupině bylo ošetřeno 30 potkanů pomocí sutury, zbývajících 30 potkanů bylo ošetřeno fibrinovým lepidlem. Po 30 dnech byli potkani utraceni a ischiadické nervy byly histologicky vyšetřeny s morfometrickými a statistickými analýzami.

Výsledky. Při mikrochirurgickém ošetření nervu se předpokládá, že umístění sutury způsobuje překážku rostoucím axonům a komprimuje krevní zásobení fasciklů a tím narušuje regeneraci konců přerušeného nervu po ošetření s možným vznikem neuromu. Na druhou stranu, fibrinové lepidlo je jednoduchá efektivní technika, která trvá časově kratší dobu než provedení sutury. Další výhodou této techniky bez sutury je, že brání poškození axonu jehlami a absence cizího tělesa minimalizuje zánětlivou reakci.

Závěr. Doporučujeme používat fibrinové lepidlo, protože vykazuje menší zánětlivou reakci, menší množství jizevnaté tkáně, provedení je méně časově náročné a poskytuje lepší výsledky.

PŘENOS TUKOVÉ TKÁNĚ DO M. PECTORALIS A M. LATISSIMUS DORSI – NOVÝ PŘÍSTUP K AUTOLOGNÍ REKONSTRUKCI PRSU ZALOŽENÝ NA LALOKU LATISSIMUS DORSI

Streit L., Dražan L., Schneiderová M., Kubek T., Šín P., Veselý K., Coufal O., Veselý J.

Úvod. Rekonstrukce prsu pomocí laloku latissimus dorsi patří díky své spolehlivosti celosvětově mezi nejčastěji používané techniky primární a sekundární rekonstrukce prsu. Nevýhodou je limitovaný objem přenášené tkáně. Autoři prezentují své zkušenosti s použitím laloku latissimus dorsi v kombinaci s přenosem tukové tkáně do m. pectoralis a do m. latissimus dorsi při sekundární rekonstrukci prsu.

Soubor pacientů a metody. Do souboru bylo zařazeno 14 pacientek, u kterých byla v období od roku 2013 do 2016 provedena jednostranná sekundární rekonstrukce prsu lalokem latissimus dorsi v kombinaci s přenosem tukové tkáně do m. pectoralis a m. latissimus dorsi. Tuková tkáň byla přenášena mezi svalová vlákna pod vizuální kontrolou. Přenesením tukové tkáně získává prsní sval významně na objemu a má nápadně vyklenutý tvar („autoprotéza“).

Výsledky. Průměrný věk pacientek v souboru byl 48,2 let (od 34 do 64 let). Průměrný objem přenášeného tuku byl 86,4 ml (od 50 ml do 160 ml), přičemž většina tukové tkáně byla aplikována do m. pectoralis. Nebyly pozorovány poruchy hojení laloku latissimus dorsi ani jiné chirurgické komplikace spojené s přenosem tukové tkáně. Nejčastější komplikací byly seromy v oblasti odběrového místa na zádech, které se vyskytovaly u 57,1 % pacientek. Počet a velikost benigních olejových cyst a tukových nekróz byl signifikantně nižší ve svalových vrstvách rekonstruovaného prsu než v podkoží.

Závěr. Přenos tukové tkáně do m. pectoralis a m. latissimus dorsi zvětšuje objem prsu při rekonstrukci lalokem latissimus dorsi, je tak eliminována potřeba použití implantátu a komplikace s tím spojené. Bylo potvrzeno, že m. pectoralis a m. latissimus dorsi jsou vhodnými recipienty pro přenos tukové tkáně.

BÝVÁ GLOMUS TUMOR DIAGNOSTIKOVÁN ČASNĚ?

Pilný J., Švarc A., Vodová H., Kletenský J., Tichá P., Sukop A.

Úvod. Glomus tumor je vzácný benigní vaskulární tumor. Ačkoli příznaky specifické pro toto postižení jsou celkem jasné, stále přetrvává prodlení mezi začátkem obtíží a stanovením diagnózy a případným operačním řešením. Autoři sledují dobu od počátků obtíží po stanovení diagnózy a vyřešení problémů.

Materiál a metodika. V letech 2004–2012 bylo diagnostikováno celkem 5 pacientů s prokázaným glomus tumorem v subunguální oblasti distálních článků prstů ruky. Šlo o 3 ženy a 2 muže průměrného věku 32,2 roků (26–47 roků). Při prvním vyšetření jsme sledovali dobu trvání obtíží, počet a odbornost lékařů, kteří pacienta vyšetřili, případně jaká vyšetření byla provedena. Při pozitivitě testu chladem, byla u všech pacientů provedena MRI. Pacienti byli indikováni k operační revizi. Vzorky tkání byly u všech pacientů histologicky ověřeny. Pacienti byli sledováni po dobu 2 let.

Výsledky. Bylo zjištěno, že pacienti měli klinické příznaky v průměru 2,4 roků. U našeho souborů byli pacienti vyšetřeni v průměru u 5,4 lékařů (3–9 lékařů). Při vyšetření před operací byly zaznamenány ve třech případech změny v oblasti nehtového lůžka, u dvou pacientů nebyly žádné změny. Při sledování pacientů 2 roky od operace došlo u jedné pacientky k recidivě obtíží s nutností reoperace. U jedné pacientky byla deformita nehtu. Recidivu jsme zaznamenali v jednom případě.

Diskuze. Protože glomus tumor je vzácnou afekcí, vyskytující se nejčastěji v oblasti nehtového lůžka, jeho včasná diagnóza je stále problémem. I v literatuře se setkáváme s podobným odstupem od počátků příznaků po stanovení diagnózy od 1,9 roku do 8 let.

Závěr. Přestože klinické příznaky obtíží u glomus tumoru jsou velmi sugestivní, stále přetrvává problém s jeho včasnou diagnostikou. Bylo by jistě přínosné, kdyby byli pacienti s přetrvávajícími obtížemi odesíláni nikoli dalším a dalším odborníkům, ale přímo na specializovaná pracoviště, která se s problematikou chirurgie ruky zabývají.

SOUČASNÝ POHLED NA OŠETŘENÍ PORANĚNÉHO PERIFERNÍHO NERVU

Kaiser R., Ullas G., Havránek P., Homolková H., Miletín J., Tichá P., Sukop A.

Přestože rekonstrukční chirurgie nervů prodělala během uplynulých 40 let díky experimentálnímu a klinickému výzkumu významný pokrok, zůstávají poranění periferních nervů stále výzvou mikrochirurgie. I když jsou v literatuře výsledky těchto výkonů často hodnoceny jako velmi dobré, vždy se jedná o dosažení užitečné, nikoliv plné funkce. Takový výsledek operace je spíše raritní. Nejedná se totiž o pouhou suturu, úspěch je dán funkční regenerací a zapojením nervových vláken. To je limitováno nejen správností chirurgické techniky, ale i věkem pacienta, latencí od úrazu a jeho mechanismem či lokalizací poranění. Některá zranění navíc zůstávají i v dnešní době neřešitelná (nejtěžší léze plexus brachialis, dlouhá trakční poranění n. peroneus). Kromě standardně používané neurolýzy a epi- nebo perineurální sutury s nebo bez použití štěpů se v poslední době dostávají do popředí distální nervové transfery (u proximálních poranění) a end-to-side anastomóza (zejména u postižení senzitivních nervů). Budoucnost však náleží ovlivnění regenerace nervů na buněčné úrovni látkami s růstovým potenciálem. Hlavním předpokladem úspěšné chirurgické léčby ale zůstává časná indikace chirurgické revize ve specializovaném centru.

SUBAKUTNÍ TEPENNÉ KRVÁCENÍ PO MASTOPEXI S AUGMENTACÍ PRSOU IMPLANTÁTY: KAZUISTIKA

Vikšraitis S., Zacharevskij E., Baranauskas G.

Augmentace prsou implantáty je jedna z nejčastěji prováděných operací v plastické chirurgii. Cílem operace je zvýšení velikosti, tvaru nebo plnosti prsu. Dosahuje se to umístěním silikonového, salinického nebo alternativního kompozitního prsního implantátu pod hrudní svaly, fascii nebo prsní žlázu. Tento typ operace není výjimkou z hlediska výskytu komplikací. Nejčastější časné komplikace

zahrnují infekční proces, serom a hematom, a pozdní zahrnují kapsulární kontrakturu, reoperaci, odstranění implantátu, asymetrii prsu a rupturu nebo deflaci implantátu. Autoři představují případ subakutního arteriálního krvácení po simultánní mastopexi a augmentaci prsou se silikonovými implantáty u 27leté ženy. Pacientka si stěžovala na zhoršování otoku a bolesti pravého prsu. Pacientka neudávala žádné trauma. Ultrazvukové vyšetření ukazovalo 2,5 cm velkou heterogenní tekutinovou kolekci kolem implantátu. Proto byla provedena revizní operace a byl odstraněn hematom o objemu 650 ml. Bylo zjištěno krvácení z větve interní mamární tepny. Po revizi byl implantát vrácen zpět do lůžka. Pooperační období bylo bez příhod. Tato kazuistika představuje popis subakutního hematomu po současné mastopexi a augmentaci prsou silikonovými implantáty, což je extrémně vzácný stav v estetické chirurgii.

PŘENOS AUTOLOGNÍ TUKOVÉ TKÁNĚ, LIPOMODELACE PRSU A LIPOFILLING OBLIČEJE: SOUČASNÉ STANDARDY REFLEKTUJÍCÍ NOVÉ POZNATKY

Streit L., Lhotský R., Měšťák O.

Přenos autologní tukové tkáně zažil v posledních letech obrovský rozmach v plastické chirurgii. Je používán za účelem doplnění objemu, zlepšení tvaru těla a obličeje, kde má i rejuvenační účinky. Mezi jednotlivými autory dosud není úplná shoda v názorech na používanou techniku odběru, zpracování a aplikace tukové tkáně. Autoři v tomto přehledovém článku doplnili přehled literatury i o své zkušenosti s odběrem, zpracováním a aplikací tuku. Navíc jsou diskutovány nejčastější indikace pro fat grafting – lipomodelace prsu a lipofiling obličeje a jejich komplikace.

INSTRUCTIONS TO THE AUTHORS

ACTA CHIRURGIAE PLASTICAE, 59, 2, pp. 112-115

The journal *Acta Chirurgiae Plasticae* is an international journal of plastic surgery. It is published in English with Czech/Slovak structured abstracts four times a year. There are articles dealing with problems of plastic, reconstructive and aesthetic surgery, craniofacial surgery, hand surgery, microsurgery, burns and allied and cooperating fields of medicine. The journal accepts the following types of articles for publication: original scientific papers including experimental studies, case reports, review articles, discussions, reviews of domestic and foreign publications, news (invitations to specialized meetings, reports from congresses and meetings, letters to the editors, etc.) and other important information from the specialty. All articles are subject to a peer review procedure, whereas bilateral anonymity is maintained. The editorial board accepts articles in English, or possibly after a previous agreement also in Czech and Slovak languages. Only articles that have not been previously published elsewhere can be accepted.

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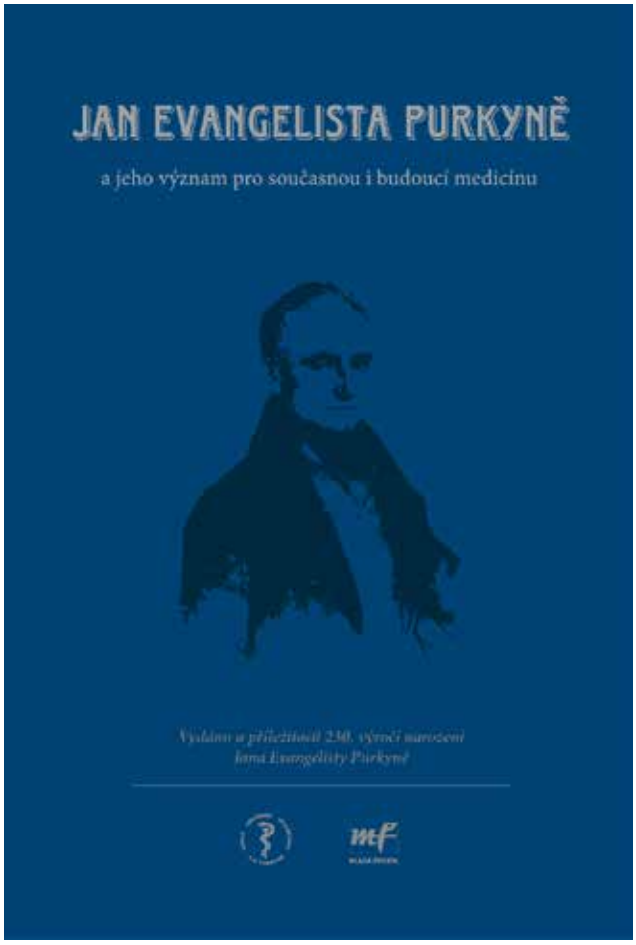

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