South Russian Journal of Cancer 2020, v.1, №3, p. 18-26
https://doi.org/10.37748/2687-0533-2020-1-3-2

ORIGINAL ARTICLE

USE OF SKIN-FASCIAL FLAPS ON PERFORATING VESSELS IN THE SURGICAL TREATMENT OF SKIN MELANOMA

Yu.V.Przhedetskiy, V.V.Pozdnyakova, N.A.Maximova, O.V.Khokhlova*, N.A.Zakharova, M.G.Ilchenko, V.Yu.Przhedetskaya

National Medical Research Centre for Oncology of the Ministry of Health of Russia,
63 14 line str., Rostov-on-Don 344037, Russian Federation

ABSTRACT

Purpose of the study. Improving the results of surgical treatment of melanoma of the skin of the extremities by using skin-fascial flaps on perforating vessels.

Patients and methods. In 42 patients with limb skin melanoma T1–3N0M0, the closure of a skin defect was performed by islet flaps on perforating vessels. Perforating vessels of the donor zone were detected with an assessment of the blood supply of the flaps in the pre- and postoperative period using ultrasound and marking of perforants with adjustment of the preliminary marking of the flaps.

Results. Permanent perforating vessels with a diameter of more than 1 mm were used. After excision of the tumor, on the opposite sides of the wound defect, taking into account the location of the perforating vessels, flaps were taken, with further mobilization by excision of the fiber and muscle fascia, they were separated from the underlying tissues while maintaining the integrity of the supply vessels. The circulatory state of the selected flaps was determined by skin color and capillary response to digital pressure. The flaps were displaced to the center, covered the area of the defect and sutured with single sutures, the edges of the donor wound were mobilized, sutured with single sutures until light tension appeared and sutured into the remaining wound defect. In the postoperative period, the determination of the parameters of the blood flow of perforating vessels showed the absence of hemodynamically significant violations of the blood flow during the movement of the flap. Transient ischemia of one of the oncoming flaps after surgery developed in 11.9%, marginal necrosis of the distal flap — in 7.1% of cases. A normotrophic scar was formed, with a width of not more than 0.3 cm, which aesthetically satisfied 92.8% of patients. Assessment of two-year relapse-free survival showed a complete absence of local relapses.

Conclusion. The flaps vascularized by perforating vessels have high viability, are identical in color and texture to the skin of the recipient area, and the close proximity to the receiving area contributes to minimal deformation of the donor area, which increases the radicality of the operation, reduces the incidence of postoperative complications and improves aesthetic and functional results.

Keywords:
limb skin melanoma, islet skin-fascial flaps, perforating vessels, ultrasound, blood flow intensity of perforating vessels

For correspondence:
Olga V. Khokhlova – Cand. Sci. (Med.), senior researcher of the Department of reconstructive plastic surgery and Oncology National Medical Research Centre for Oncology of the Ministry of Health of Russia, Rostov-on-don, Russian Federation.
Address: 63 14 line str., Rostov-on-Don 344037, Russian Federation
E-mail: ysol@yandex.ru
ORCID: https://orcid.org/0000-0001-7413-8393
SPIN: 9529-9680, AuthorID: 736629
Scopus Author ID: 57188731183

Information about funding: no funding of this work has been held.
Conflict of interest: authors report no conflict of interest.

For citation:
Przhedetskiy Yu.V., Pozdnyakova V.V., Maksimova N.A., Khokhlova O.V., Zakharova N.A., Ilchenko M.G., Przhedetskaya V.Yu. Use of skin-fascial flaps on perforating vessels in the surgical treatment of skin melanoma. South Russian Journal of Cancer. 2020; 1(3): 18-26.
https://doi.org/10.37748/2687-0533-2020-1-3-2

Received 26.12.2019, Review (1) 13.03.2020, Review (2) 30.06.2020, Accepted 01.09.2020

Южно-российский онкологический журнал 2020, т.1, №3, с. 18-26
https://doi.org/10.37748/2687-0533-2020-1-3-2
ОРИГИНАЛЬНАЯ СТАТЬЯ

ИСПОЛЬЗОВАНИЕ КОЖНО-ФАСЦИАЛЬНЫХ ЛОСКУТОВ НА ПЕРФОРАНТНЫХ СОСУДАХ В ХИРУРГИЧЕСКОМ ЛЕЧЕНИИ МЕЛАНОМЫ КОЖИ

Ю.В.Пржедецкий, В.В.Позднякова, Н.А.Максимова, О.В.Хохлова*, Н.А.Захарова, М.Г.Ильченко, В.Ю.Пржедецкая

ФГБУ «НМИЦ онкологии» Минздрава России,
344037, Российская Федерация, г. Ростов-на-Дону, ул. 14-я линия, д. 63

РЕЗЮМЕ

Цель исследования. Улучшение результатов хирургического лечения меланомы кожи конечностей с использованием кожно-фасциальных лоскутов на перфорантных сосудах.
Пациенты и методы. 42 больных меланомой кожи конечностей T1–3N0M0. Закрытие кожного дефекта выполнялось островковыми лоскутами на перфорантных сосудах. Детекцию перфорантных сосудов донорской зоны с оценкой кровоснабжения лоскутов осуществляли в пред- и послеоперационном периоде с помощью УЗИ и производили их маркировку с последующей корректировкой предварительной конфигурации лоскутов.
Результаты. Использовались постоянные перфорантные сосуды диаметром более 1 мм. После иссечения опухоли на противоположных сторонах раневого дефекта, учитывая расположение перфорантных сосудов, выкраивали лоскуты по разметке, рассекая кожу, жировую клетчатку и фасцию подлежащей мышцы, отделяли лоскут от мышечной ткани, сохраняя при этом целостность перфорантных сосудов. Состояние кровообращения лоскутов определяли по цвету кожи и капиллярного ответа на пальцевую компрессию. Лоскуты смещали к центру, укрывали область дефекта и сшивали между собой, края донорской раны мобилизовывали, ушивали одиночными швами до края перемещенных лоскутов. В раннем послеоперационном периоде исследование параметров кровотока в перфорантных сосудах выявило отсутствие гемодинамически значимых нарушений. Преходящая ишемия одного из встречных лоскутов после операции развилась в 11,9% наблюдений, краевой некроз дистального лоскута — в 7,1% случаев. Формировался нормотрофический рубец, шириной не более 0,3 см, который эстетически удовлетворял 92,8% пациентов. Двухлетняя безрецидивная выживаемость показала отсутствие местных рецидивов.
Заключение. Лоскуты на перфорантных сосудах высоко жизнеспособны, сопоставимы по текстуре и цвету коже реципиентной области, а близость лоскутов к воспринимающему ложу минимально деформирует донорскую зону, что повышает радикальность операции, снижает число послеоперационных осложнений и повышает эстетические и функциональные результаты.

Ключевые слова:
меланома кожи конечностей, островковые кожно-фасциальные лоскуты, перфорантные сосуды, ультразвуковое исследование, интенсивность кровотока перфорантных сосудов

Для корреспонденции:
Хохлова Ольга Викторовна – к.м.н., старший научный сотрудник отделения реконструктивно-пластической хирургии и онкологии ФГБУ «НМИЦ онкологии» Минздрава России, г. Ростов-на-Дону, Российская Федерация.
Адрес: 344037, Российская Федерация, г. Ростов-на-Дону, ул. 14-я линия, д. 63
E-mail: ysol@yandex.ru
ORCID: https://orcid.org/0000-0001-7413-8393
SPIN: 9529-9680, AuthorID: 736629
Scopus Author ID: 278641

Информация о финансировании: финансирование данной работы не проводилось.
Конфликт интересов: авторы заявляют об отсутствии конфликта интересов.

Для цитирования:
Пржедецкий Ю.В., Позднякова В.В., Максимова Н.А., Хохлова О.В., Захарова Н.А., Ильченко М.Г., Пржедецкая В.Ю. Использование кожно-фасциальных лоскутов на перфорантных сосудах в хирургическом лечении меланомы кожи. Южно-российский онкологический журнал. 2020; 1(3): 18-26. https://doi.org/10.37748/2687-0533-2020-1-3-2

Получено 26.12.2019, Рецензия (1) 13.03.2020, Рецензия (2) 30.06.2020, Принята к печати 01.09.2020

ABSTRACT

The incidence of cutaneous melanoma is increasing worldwide on average 2 times every 15 years [1], and the frequency of deaths is up to 80% of cases among all forms of malignant skin tumors [2, 3]. Surgical method is the main in treatment of the disease, but replacement of the skin defect often causes difficulties due to lack of local tissues or unfavorable for the healing of autodermatoplasty, in connection with the peculiarities of the recipient bed and the deficit area of the surrounding skin [4]. These problem areas are the upper and lower extremities, and the localization of skin melanoma in this area occurs in 73.4% of cases.

One of the main tasks in plastic closure of defects is to preserve the viability of displaced tissue fragments with their primary engraftment in the receiving bed, which depends on an accurate assessment of blood circulation in the displaced tissues [5, 6]. for closing soft tissue defects of the extremities, perforant flaps are successfully used, since the formation of such

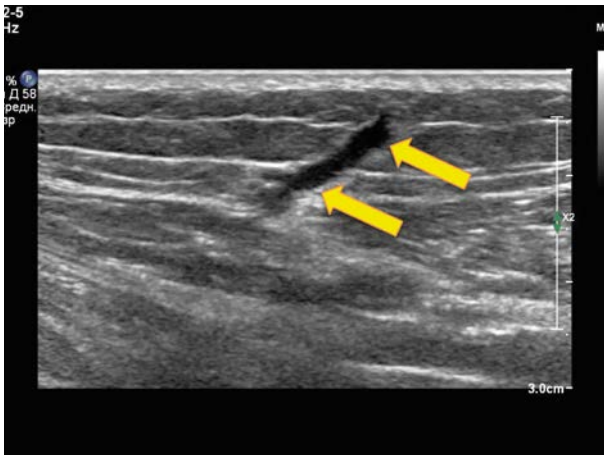

Fig. 1. image of the perforant vessel (indicated by arrows) at the broadband range of the linear sensor 18-4 MHz in the mode of high-contrast seroscale sonography.

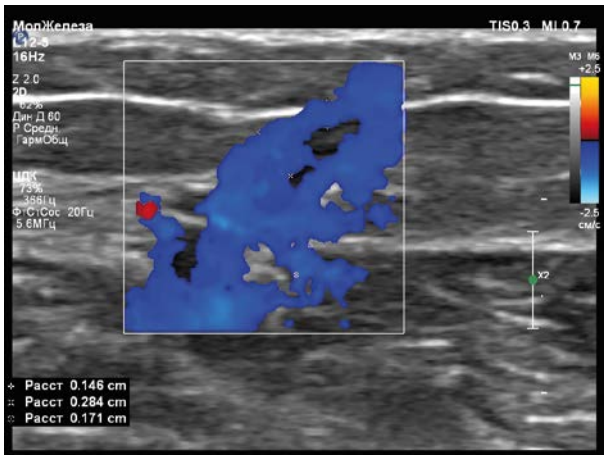

Fig. 2. Branched network of perforant veins in magnification mode with color Doppler mapping of blood flow, measurement of tributary diameters (D=0.1 cm, D=0.2 cm, D=0.3 cm).

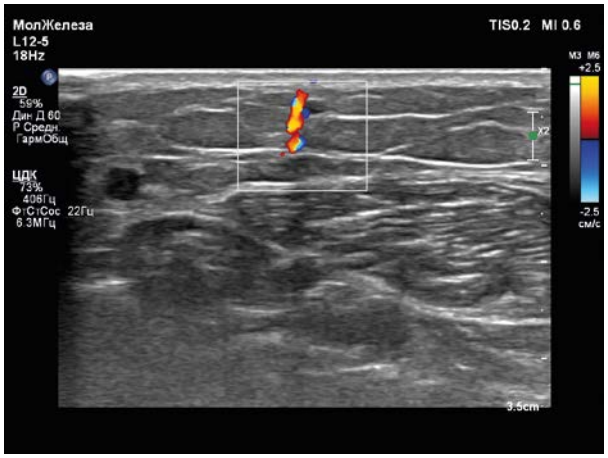

Fig. 3. Perforant artery in color Doppler mapping mode.

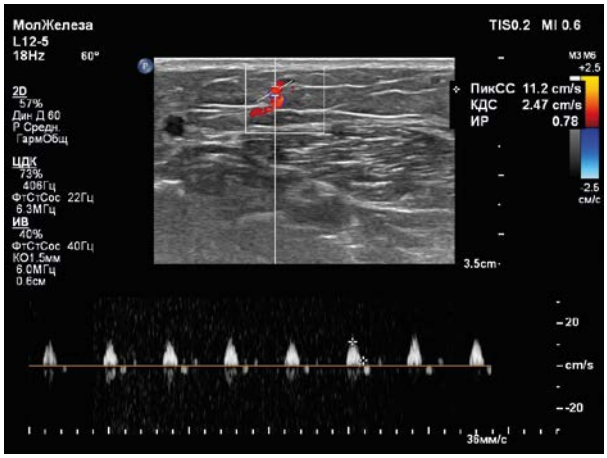

Fig. 4. Dopplerometry-determination of maximum velocity parameters in the perforant artery (MAS-11.2 cm / s).

flaps is not associated with significant trauma of the donor zone, which allows for the plasticization of skin defects with tissue complexes from the same anatomical area. These flaps are identical in color, texture and texture to the lost tissues, therefore, they contribute to a favorable course of the postoperative period and obtain good aesthetic results [7]. The use of perforant flaps allows not to affect the main arteries, which is important for possible subsequent microsurgical reconstruction using this zone as a recipient [8].

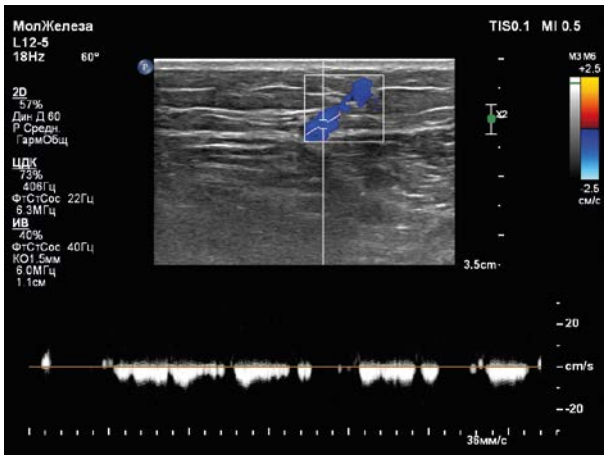

Fig. 5. identification of the perforant vein for determining the parameters of the maximum venous blood flow rate (MVS 9.0 cm / s).

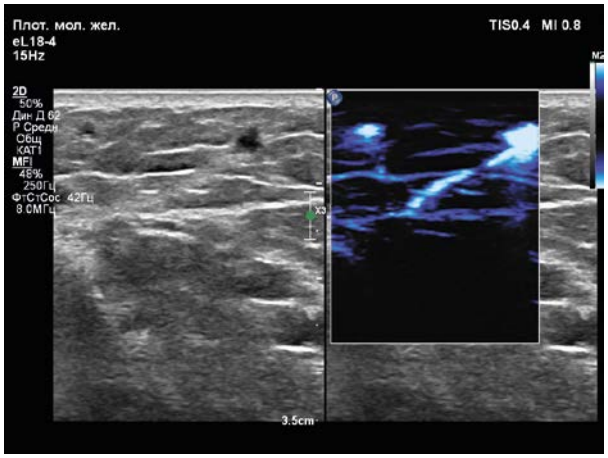

Fig. 6. Image of the microvascular network of perforant vessels in the energy Doppler mode at a broadband frequency range of 4-18 MHz when selecting appropriate vessels for moving the flap.

When the skin melanoma is located on the extremities, it is possible to use a method for replacing extensive wound defects with insular skin-fascial flaps fed through perforant vessels. Flaps of triangular or Crescent shape, there are skin-fat, with dissection at the level of subcutaneous fat (epifascial) or skin-fascial, with the release of muscle fascia (subfascial). These flaps are supplied with blood by perforant musculoskeletal vessels originating from segmental vessels that penetrate through the fascia into the subcutaneous tissue. In the flap, nutrition is provided by vascular anastomoses between the dermal-subdermal plexus and the superficial capillary plexus of the papillary layer. Knowledge of the topography of the vessels feeding the flap affects the duration of the operation, its trauma, the possibility of successful isolation of the tissue complex, as well as the course and duration of the postoperative period [5].

The purpose of the study: To improve the results of surgical treatment of melanoma of the skin of the extremities by plasticizing the soft tissue defect with flaps based on perforant vessels.

PATIENTS AND METHODS

The work was performed at the Department of reconstructive plastic surgery and Oncology

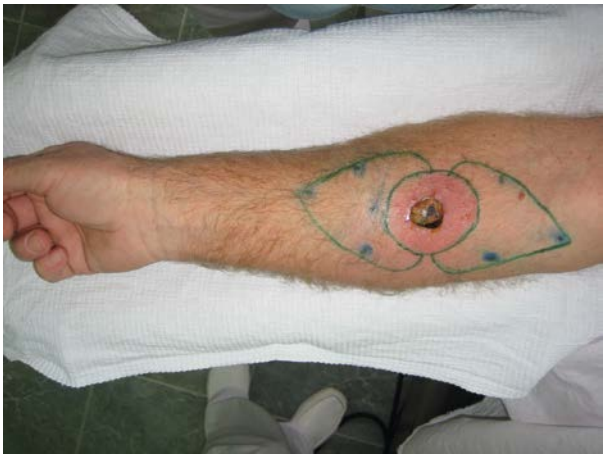

Fig. 7. Perforant vessels are marked with dots on the marking of future flaps.

of the FGBU "NMRC Oncology" of the Ministry of health of Russia in 2015–2020. The study was approved by the local independent ethics Committee of the Rostov cancer research Institute of the Russian Ministry of health IN 2015. All patients signed informed voluntary consent to the use of biological material for scientific purposes.

The study included 48 patients with histologically confirmed skin melanoma of the extremities T1–3N0M0. All patients underwent a surgical stage of treatment with a wide excision of the primary focus and subsequent closure of the skin defect with islet flaps on the perforant vessels. The criteria for inclusion in the study were: the size of the tumor is not more than 25% of the perimeter of the limb at the level of the lesion, the presence of perforant vessels of acceptable diameter in the area of interest (at least 1 mm according to ultrasound scanning). The majority of patients were women-26 (54.2%), men — 22 (47.8%). The average age of patients was 51.7±8.7 years.

Nodular morphological form was found in most cases and accounted for 81.3% (39 out of 48 patients), surface-spreading form was observed in 18.7% (9 out of 48 patients). According to the localization of the neoplasm, the patients were distributed as follows: shoulder-8 (16.7%) patients, forearm — 13 (27.1%), hip — 5 (10.4%), lower leg — 22 (45.8%) patients. Stage I of the process was diagnosed in 8(16.7%) patients, stage II — in 17 (35.4%), stage III — in 23 (47.9%) patients.

When planning the operation, the assessment of the future wound defect was carried out on the basis of the principles of oncosurgery, taking into account the size, shape, depth of tumor invasion and tissue condition, taking into account the operations, radiation therapy and other factors.

The detection of perforant vessels, vessel diameter, and blood flow intensity (MAS — maximum arterial speed and MVS-maximum venous speed) was performed in the pre — and postoperative period (on day 5–7) on the epiq 5 ultrasound device (Phillips) with broadband multi-frequency sensors with a frequency range of 4–18 MHz in the modes of energy, color, (EDM and CDM) and spectral Doppler mapping. The blood flow rate was classified as low — up to 5 cm/s, average–5.1–10.0 cm/s, high — from 10.1 cm/s or more). The type of blood flow was also differentiated (arterial or venous)) (fig. 1–6).

Table 1. The distribution of perforant vessels in diameter

The diameter of perforant vessels, mm	The number of perforant arteries		The number of perforant veins	
	Abs.	%	Abs.	%
1.0-1.5	120	51.7	92	41.1
1.6-2.0	82	35.3	88	39.3
2.1-3.0	30	13.0	44	19.6
The total:	232	100	224	100

The range of the maximum blood speed, cm/s		Average value of the maximum arterial speed, cm / s		The range of maximum venous speed, cm/s		Average value of maximum venous speed, cm / s	
Before the surgery	After the surgery	Before the surgery	After the surger	Before the surgery	After the surger	Before the surgery	After the surger
5-25	5-18	14.2±5.3*	12.1±3.2*	5-12	5-10	9.1±1.3**	7.3±1.2**

Note: *-* * $p>0.05$ (the differences are not valid)

Before the surgery, perforants were detected on the skin with their marking using ultrasound examination, if necessary, with subsequent correction of pre-marked flaps (fig. 7). At the same time, it was necessary to include at least one arterial and one venous perfor-mant vessels in each flap.

If necessary, the shape and location of the flaps changed depending on the topography of the vessels.

RESEARCH RESULTS AND DISCUSSION

During the study, it was found that the surface-spreading type of skin melanoma growth in 100% of the observations had the avascular type of ultrasound image, and the nodular forms — the arterio-arterial type of blood flow (100%) of high and medium intensity (95%). For nodal forms, the characteristic feature was a branched vascular network with multiple vessels of different diameters, the presence of pathological anastomoses and pseudopulse, which are quite typical for neoangiogenesis processes, with a MAS range of 5.3–47.8 cm/s [9, 10].

By ultrasound scanning have been identified peculiarities of topographic anatomy of perforating vessels of the extremities. Most often, non-permanent perforant vessels were detected in the areas that were later used by us during the closure of the wound defect. Thus, the proportion of non-permanent arterial perforant vessels in the upper extremities was: on the shoulder — 60.0% (24 out of 40 perforant arteries), on the forearm — 64.1% (41 out of 64). The assessment of the topographic anatomy of the perforated vessels of the lower extremities also showed the prevalence of non-permanent arteries: on the hip, their share was 56.0% (14 out of 25 detected vessels), and on the lower leg, 80.9% (85 out of 105 detected vessels). It was shown that the most constant perforating vessels was on the front of the thigh — from the pool of hip and knee arteries; on the back of the thigh from the popliteal artery and the medial artery, the envelope of the femur and on the lateral surface of the femur — from the deep femoral artery. The results of this part of the study we can conclude that pre-Doppler monitoring of blood vessels of the donor area when planning for reconstructive plastic surgery is mandatory, because of different localization of pathological formations, as well as a pronounced variability of the vascular topography of the limbs compared to the torso. Earlier, ultrasound scanning in CDM and EDM modes revealed different types of vascularization and blood flow intensity of the pathological foci themselves.

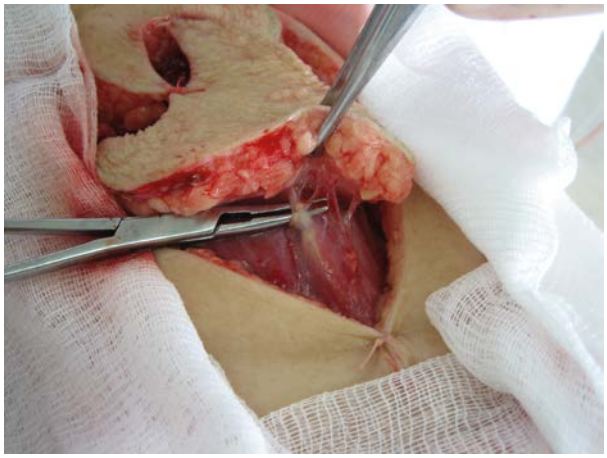

Fig. 8. Skin-fascial flaps are mobilized and fixed with a bridging suture. In the venous clip shows a perforating vessel.

Fig. 9. The appearance of the wound after the surgery. The flaps are displaced along the length and width in the direction of the tissue defect and are sewn together.

Fig. 10. Aesthetic and functional result of plastic closure of the defect with counter-perforant flaps after 6 months.

Fig. 11. Aesthetic and functional result of plastic closure of the defect of the medial surface of the forearm with counter-perforant flaps after 8 months.

Fig. 12. Aesthetic and functional result of plastic closure of the defect of the lateral surface of the forearm with counter-perforant flaps after 6 months.

When evaluating the size of perforant vessels, it was shown that their internal diameter was from 1 to 3 mm, with a predominance of the range of 1.0–1.5 mm for both arterial and venous vessels (table 1).

Then, under ultrasound control, the identified perforators were marked on the skin, the shape and location of the flaps were corrected, taking into account the vascular architectonics of the donor zone. Under local anesthesia, the pathological focus was excised, retreating to the necessary distance, ensuring the radical nature of the surgical intervention. The most rational, in our opinion, is a circular incision around the pathological focus, since it allows you to remove an equal amount of skin around the tumor from all sides without unnecessary resection of intact surrounding tissues.

On the opposite sides of the defect, triangular or horseshoe-shaped flaps were cut out, taking into account the localization of the perforant vessels. Additional flap mobilization was performed by cutting through the muscle fascia, then the skin-fascial flap was bluntly separated from the underlying tissues while preserving the integrity of the feeding vessels (fig. 8).

It should be noted that hemostasis on the flap was performed exclusively in the bipolar mode, since coagulation of the bleeding vessel on the mobilized flap in the monopolar mode is fraught with coagulation of the perforant vessels, as the only current-conducting bridges. Perfusion of flaps isolated on vascular legs was assessed using two main clinical symptoms: skin color and the rate of capillary response to compression of the flap with a finger. Then the flaps were moved to each other, closing the area of the defect directly or with a lateral offset and sewn together. The skin edges of the donor area mobilized, the distal wound was sutured "on" until a slight tension, then the flaps are sutured by single stitches in the wound defect in the receptor zone. Wounds were drained by rubber graduates in order to prevent compression of the vascular pedicle by the wound separable (fig. 9). the Sutures were removed after 12–16 days.

Ultrasound examination of the blood flow rate in the perforant vessels before surgery found that the linear blood flow rate in the perforant arteries varied from 5 to 25 cm/s (on average, 14.2±5.3 cm/s), and the maximum venous velocity was from 5 to 12 cm/s (on average, 9.1±1.3 cm/s) (table 2).

Determination of blood flow parameters of perfor-manent vessels in the early postoperative period showed that the average MAS was 12.1±3.2 cm/s versus 14.2±5.3 cm/s at the preoperative stage, and the average MVS was 7.3±1.2 cm/s versus 9.1±1.3 cm/s, respectively, which can be regarded as a slight (statistically unreliable) decrease in the hemodynamics of tissue fragments after their movement (table 2).

When assessing the condition of the displaced flaps, in some cases, transient ischemia of one or both flaps was detected, which developed in 5 (10.4%), and marginal necrosis of the distal flap — in 3 (6.3%) cases. When evaluating the aesthetic and functional results, it was noted that in most cases an elastic normotrophic scar was formed, up to 0.2 cm wide, which satisfied 91.7% of patients (fig. 10–12). In 4 patients, the formation of long-term non-maturing hypertrophic scars in places of maximum tissue tension was noted.

CONCLUSIONS

With correct ultrasound detection of perforant vessels, skin-fascial flaps retain a high blood supply potential, correspond in texture, texture and color to the skin of the recipient area, and their proximity to the receiving zone contributes to minimal scarring and contour deformation of the donor area. Preoperative ultrasound diagnostics of perforant vessels contributes to the optimal choice of the location and shape of the flap with the inclusion of arterial and venous vessels of sufficient diameter in its composition. The proposed method of surgical treatment of melanoma of the skin of the extremities significantly increases the radicality of the operation due to the possibility of plastic cover of the resulting defect, reduces the frequency of postoperative complications in comparison with traditional methods of wound closure and improves the aesthetic and functional results.

Authors contribution:
Przhedetskiy Yu.V. – research concept and design, operation, scientific editing of the material.
Pozdnyakova V.V. – technical editing of the article material.
Maksimova N.A. – collection, analysis and interpretation of ultrasound data, preparation of illustrations.
Khokhlova O.V. – operating, assisting on operations, text writing.
Zakharova N.A. – materials processing.
Ilchenko M.G. – collection, analysis and interpretation of data, preparation of illustrations.
Przhedetskaya V.Yu. – design of the bibliography, technical design of the article.

References

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2015. CA Cancer J Clin. 2015 Feb; 65(1):5–29. https://doi.org/10.3322/caac.21254
2. Pak D.D., Lazutina T.N. Skin Tumors. Oncology, National Guideline. Moscow, 2014, 848–863. (In Russian).
3. Kit OI, Dashkova IR, Vashchenko LN. The use of reconstructive plastic surgery in the treatment of malignant tumors. Novocherkassk. 2017;192–202. (In Russian).
4. Azimova RB, Sobolevsky VA. Perforator flaps in distal lower leg: evolution and clinical applications. Sarcomas of Bones, Soft Tissues and Skin Tumors. 2016;2:54–60. (In Russian).
5. Garelik EI, Gileva KS, Abdullaev KF, Vasiliev EA, Orlova EV. Anatomic explora-tion of the anterolateral thigh perforator flap. Annals of Plastic, Reconstruc- tive and Aesthetic Surgery. 2016;4:20–26. (In Russian).
6. Maksimova NA, Przhedeckij YuV, Hohlova OV, Pozdnyakova VV, Il'chenko MG, Maksimova MI. Ultrasound scan in planning surgery for cutaneous melanoma of the extremities. Siberian journal of Oncology. 2019;18(1):95–102. https://doi.org/10.21294/1814–4861–2019–18–1–95–102.

7. Hwang KT, Kim YH. Double skin perforator flaps for aesthetic resurfacing of extensive limb defects. J Plast Reconstr Aesthet Surg. 2015 Feb;68(2): E47–E49.
https://doi.org/10.1016/j.bjps.2014.10.051
8. Mel'nikov VS, Korshunov VF, Romanov SYu, Magnitskaya NE. Reconstruction of soft tissue of hand using island and perforator flap. Traumatology and Orthopedics in Russia. 2014;(3(73)):39–43.
9. Allakhverdyan GS, Chekalova MA. Preoperative evaluation of primary skin melanoma by ultrasound. Ultrasound and Functional Diagnostics. 2015;(4S):16a. (In Russian).
10. Maksimova NA, Pozdnyakova VV, Kuryshova MI, Ilchenko MG. Ultrasound Diagnosis of Melanocytic Skin Neoplasms. Modern Problems of Science and Education. 2015;(3):182.

Information about author:

Yury V. Przhedetskiy – Dr. Sci. (Med.), professor, head of the department of reconstructive plastic surgery and oncology National Medical Research Centre for Oncology of the Ministry of Health of Russia, Rostov-on-don, Russian Federation. ORCID: https://orcid.org/0000-0003-3976-0210, SPIN: 3888-6265, AuthorID: 702006, ResearcherID: ATT-7598-2020, Scopus Author ID: 57188731912

Viktoriya V. Pozdnyakova – Dr. Sci. (Med.), professor, senior researcher of the Department of reconstructive plastic surgery and Oncology National Medical Research Centre for Oncology of the Ministry of Health of Russia, Rostov-on-don, Russian Federation. ORCID: https://orcid.org/0000-0002-3782-6899, SPIN: 7306-2034, AuthorID: 700139, ResearcherID: ATT-6707-2020, Scopus Author ID: 54380529400

Nataly A. Maximova – Dr. Sci. (Med.), professor, head of the radioisotope laboratory with ultrasound diagnostics group National Medical Research Centre for Oncology of the Ministry of Health of Russia, Rostov-on-don, Russian Federation. ORCID: https://orcid.org/0000-0002-0400-0302, ResearcherID: AAT-9775-2020, Scopus Author ID: 57211495326

Olga V. Khokhlova* – Cand. Sci. (Med.), senior researcher of the Department of reconstructive plastic surgery and Oncology National Medical Research Centre for Oncology of the Ministry of Health of Russia, Rostov-on-don, Russian Federation. ORCID: https://orcid.org/0000-0001-7413-8393, SPIN: 9529-9680, AuthorID: 736629, Scopus Author ID: 57188731183

Natalia A. Zakharova – Cand. Sci. (Med.), senior researcher of the Department of reconstructive plastic surgery and Oncology National Medical Research Centre for Oncology of the Ministry of Health of Russia, Rostov-on-don, Russian Federation. ORCID: https://orcid.org/0000-0001-7089-5020, SPIN: 2182-9981, AuthorID: 706088

Maria G. Ilchenko – Cand. Sci. (Med.), research associate of the Department of tumor diagnostics National Medical Research Centre for Oncology of the Ministry of Health of Russia, Rostov-on-don, Russian Federation. ORCID: https://orcid.org/0000-0002-9126-0646, SPIN: 2856-7946, AuthorID: 734046, ResearcherID: AAT-9807-2020

Viktoria Yu. Przhedetskaya – oncologist of the Department of reconstructive plastic surgery and Oncology National Medical Research Centre for Oncology of the Ministry of Health of Russia, Rostov-on-don, Russian Federation. ORCID: https://orcid.org/0000-0002-0278-8730, SPIN: 7742-0850, AuthorID: 901373, ResearcherID: ATT-7752-2020, Scopus Author ID: 57202468879