

Results of the second toe autotransplantation for thumb reconstruction

B.Sh. Minasov, I.Z. Garapov, E.M. Biktasheva, M.M. Valeev✉, R.R. Iakupov, T.B. Minasov, T.R. Mavliutov

Bashkir State Medical University, Ufa, Russia

Corresponding author: Marat M. Valeev, valeevmm@rambler.ru

Abstract

Defects of the thumb negatively impact physical and mental health, lead to depression, inferiority complex and hopelessness in the future. The **aim** of the study was to explore long-term results of thumb reconstruction using autologous transplantation of the second toe with microvascular anastomoses. **Material and methods** Second toe transplantation for thumb reconstruction was performed for 54 patients. There were 48 male and 6 female patients aged from 12 to 55 years. When analyzing the long-term results of surgical treatment of patients. The anatomy and functionality of the repaired finger was evaluated at a long term measuring the range of motion in the joints, muscle strength of the hand and major types of hand grips. **Results** The autograft completely healed with opposition of the reconstructed thumb and the rest fingers restored in 51 patients. The autograft failed in three cases treated with less functional methods. **Conclusion** Microsurgical reconstruction technologies used for a lost thumb facilitated rapid recovery of the finger and significantly improved functions of the injured hand as an entity. Free second toe transplantation using microvascular anastomoses for the thumb reconstruction allowed the patient regain basic gripping functions and improve cosmesis of the injured hand.

Keywords: microsurgery, plastic surgery, reconstruction, toe transplantation, thumb, defect

For citation: Minasov B.Sh., Garapov I.Z., Biktasheva E.M., Valeev M.M., Iakupov R.R., Minasov T.B., Mavliutov T.R. Results of the second toe autotransplantation for thumb reconstruction. *Genij Ortopedii*, 2022, vol. 28, no 1, pp. 34-38. <https://doi.org/10.18019/1028-4427-2022-28-1-34-38>

INTRODUCTION

Traumatic finger amputation due to necrosis of soft tissues lead to persistent impairment of the hand function in 70–80 % of the cases. Absence of the thumb is the reason for a 50 % decrease in working capacity, and significant effort has been focused on thumb reconstruction [1–12]. The reconstructive thumb must have an aesthetic appearance, sufficient length and full sensitivity and provide hand grips. The opposability of the human thumb is its unique ability to oppose the other four fingers performing

subtle kinematic movements. The reconstruction technique of the thumb to maximally regain aesthetic attractiveness and functionality of the injured hand would depend on the length of the stump and the condition of the tenar muscles [2, 3, 7, 9, 13–23]. Thumb reconstruction is essential for younger patients who lose the ability to perform professional, household and social duties with traumatic thumb loss and that urges surgeons look for optimal treatments to solve the problem [24–39].

MATERIAL AND METHODS

Second toe transplantation to the thumb position was performed for 54 patients. The patients had severely impaired grip function and deviations in the psycho-emotional state due to the loss of stereotypical motor hand movements: from unmotivated irritability to unsociability, in females, in particular.

The inclusion criterion was an amputated stump of the thumb in subacute and long-term periods of injury in patients aged 12 to 55 years. The exclusion criteria were decompensated somatic pathology; infectious processes in the injured hand; mental, neurological and vascular diseases in the decompensation stage; cold injuries that led to necrosis of the fingers and toes. The reasons for the thumb loss were traumatic separations, extensive destruction of soft tissues in

the workplace or at home. There were 48 male and 6 female patients. Preoperatively, patients underwent physical and radiographical examination of the injured hand and USGD of major arteries of the involved and the donor lower limbs; age (younger than 55 years), time of injury, the dominant hand, occupation, comorbidities were considered. The skin, scars, joint mobility, pulsation of the major arteries of the limbs, functioning of the apocrine glands of the donor foot were evaluated during physical examination.

The upper limb and the hand function and activity limitations were assessed preoperatively with the Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH) that consisted mainly of a 30-item disability/symptom scale.

Calculations were produced using the formula: (the sum of answers / $n-1$) $\times 25$, with n being the number of answers completed. Preoperative score ranged from 75 to 100 points. The Kapandji thumb opposition score (1986) was used to record thumb

opposition. The functional state of the upper limb measured with the DASH and Kapanji scores were 53.9 ± 8.22 preoperatively and 54.72 ± 8.04 postoperatively, and 2.3 ± 0.34 preoperatively and 2.35 ± 0.36 postoperatively, respectively.

RESULTS

A positive result at a long term was obtained in 51 patients. The autograft failed to survive in three patients who were treated with less functional methods to improve the thumb function. The anatomy of the thumb reconstruction, the extent of the functionality regained in the injured hand, range of motion in the joints of the thumb, the muscle strength of the hand, major types of hand grip (DASH score, A.I. Kapanji score, the quality of life assessed with the SF-36 scale) were evaluated at a long term. The statistical analysis of the outcomes allowed for identifying significance of the results. Statistically significant improvement of the parameters of the injured hand was observed postoperatively with increased range of motion, improved grips and strength test loads. Assessment of the restored anatomy, the range of motion in the thumb (flexion and extension) and major types of hand grip revealed a significant improvement of the parameters in the postoperative period ($p < 0.01$) (Table 1).

Table 1

Preoperative and postoperative hand grip strength

Preoperatively	Postoperatively
Spherical grip (χ^2 Macnamara (A/D) 0.1, $p = 0.75$; (B/C) 24.04, $p < 0.001$)	
No grip	grip Av
Hook grip (χ^2 Macnamara (A/D) 4.08, $p = 0.043$; (B/C) 22.04, $p < 0.001$)	
Limited grip	grip Av
Planar grip (χ^2 Macnamara (A/D) 1.45, $p = 0.23$; (B/C) 23.04, $p < 0.001$)	
No grip	grip Av
Cylindrical grip (χ^2 Macnamara (A/D) 0.8, $p = 0.37$; (B/C) 29.03, $p < 0.001$)	
No grip	grip Av
Opposition (χ^2 Macnamara (A/D) 0.25, $p = 0.62$; (B/C) 30.03, $p < 0.001$)	
No grip	grip Av
Pinch grip (χ^2 Macnamara (A/D) 1.50, $p = 0.220$; (B/C) 29.03, $p < 0.001$)	
No grip	grip Av

Dynamometry parameters improved significantly in the postoperative period ($p < 0.01$). The upper limb function was shown to improve at a long term according to the Kapanji score ($p < 0.01$) with the range of motion measuring 7.17 ± 1.42 . A comparative assessment of

the outcomes of the thumb reconstruction with the DASH score also revealed statistically significant differences between preoperative and postoperative measurements ($p = 0.019$) 2.3 ± 0.34 . Evaluation of the quality of life on the SF-36 scale revealed significant postoperative improvements in physical functioning, role physical functioning, mental health, vitality and role emotional functioning ($p < 0.05$). High levels of personal (46.6 points) and reactive anxiety (34.5 points) were measured preoperatively with the Spielberger-Khanin anxiety test. Postoperatively, the level of personal anxiety measured 18 points and reactive anxiety was 37.8. General health and physical functioning improved after the operation. Patients showed a slight increase on the scales of role, social, emotional functioning, the scale of vitality, mental health and pain that indicated improvement in the quality of life after treatment.

A clinical example A 45-year-old patient V. presented with the thumb loss on the right side due to an occupational injury he had received 3 weeks ago (Fig. 1). The patient underwent surgery of free transplantation of the second toe on the left side to the position of the missing thumb using microvascular anastomoses (Fig. 2). Postoperative period was uneventful and the autograft survived. The patient could produce all types of hand grips at 10-year follow-up with the sensitivity completely restored in the thumb (Fig. 3).

All patients indicate the significant attractiveness of the hand with reconstructive thumb: "the hand looks like the hand."



Fig. 1 Appearance (a) and radiograph of the right hand (b) of a 45-year-old patient V. diagnosed with amputation stump of the thumb on the right side

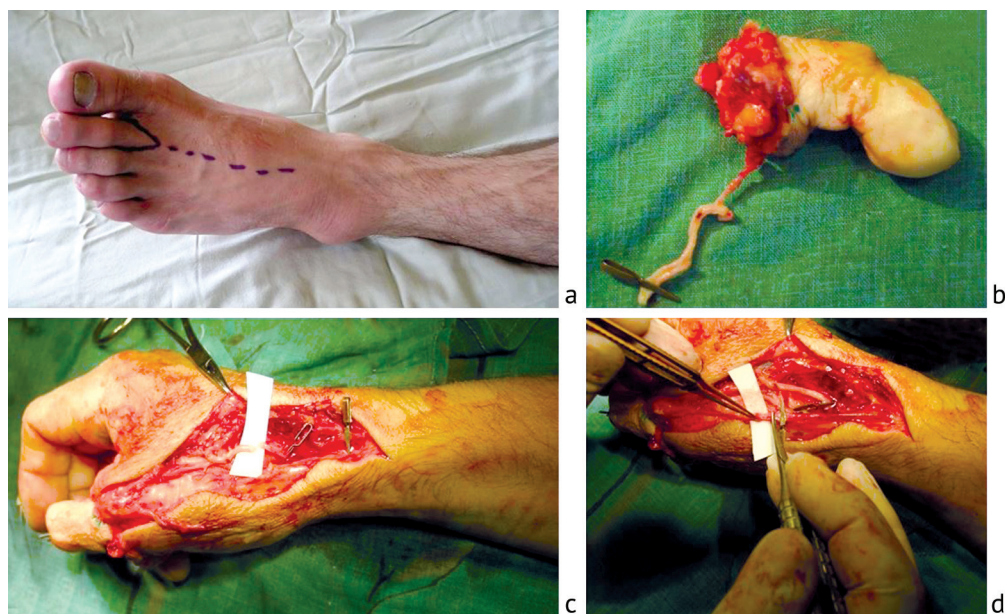


Fig. 2 Surgical stages: (a) planning surgical approach on the donor foot; (b) vascularized autograft; (c) arterial anastomosis applied; (d) venous anastomosis applied

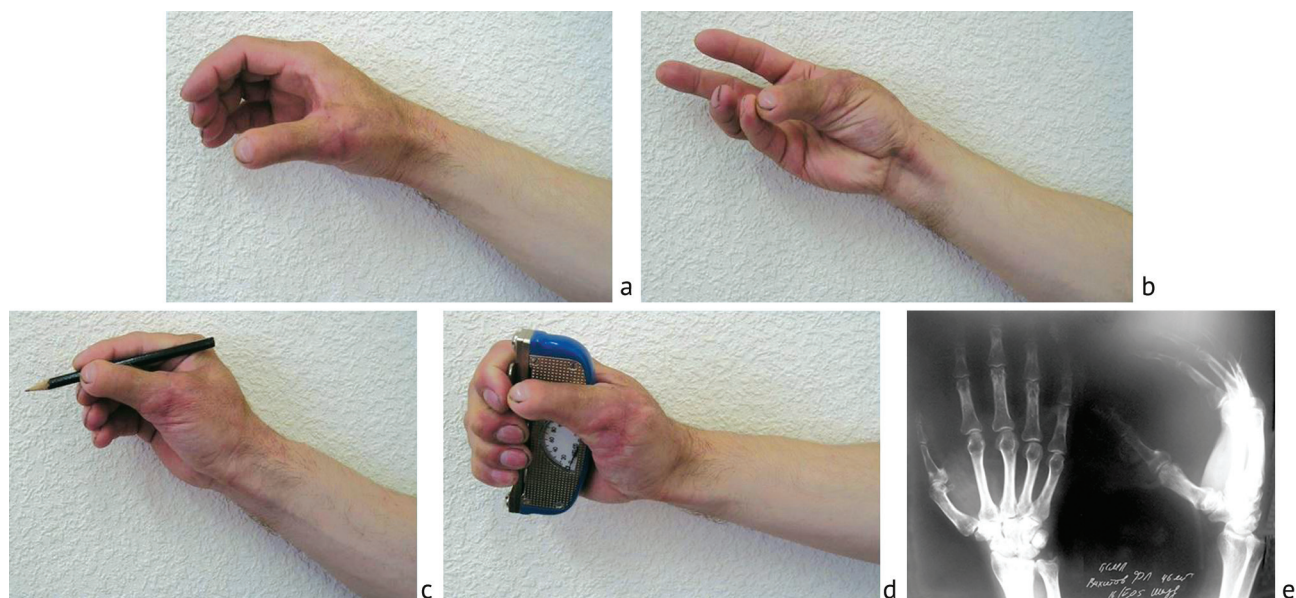


Fig. 3 Appearance (a–d) and radiograph of the right hand (e) at a long term

DISCUSSION

Planning of treatment for patients with post-traumatic defects of the thumb should be based on early reconstructive interventions of damaged structures that would optimize the patient's adaptation to the social environment, help to restore professional skills and household functionality [5, 6, 7, 9, 15, 16, 21, 23]. Many authors prefer using methods of plastic surgery with skin-bone flaps and the soft-tissue component of the newly formed thumb to be restored with the Filatov stem, the double Converse-Blokhin flap, a non-free inguinal tubular flap in thumb reconstruction. The bone frame of the thumb is formed using a fragment

of the iliac crest or radius. Such methods are characterized by multi-stage treatment and cause a lot of inconvenience for patients in the form of a long-term malpositioned limb and the development of joint stiffness, maceration sites and partial skin necrosis. The aesthetic appearance of the hand during thumb reconstruction using the above flaps leaves much to be desired. The major disadvantage of using such flaps is thought to be lack of joints in the new thumb necessary to perform various hand grips. Inability to restore the sensitivity of the flap is a significant disadvantage of thumb reconstruction using skin and bone grafts [2, 8, 11, 12, 14, 22, 24].

The above disadvantages can be avoided with the use of free transplantation of the second toe on microsurgical anastomoses for thumb reconstruction. The technique allows one-stage thumb reconstruction with complete restoration of all anatomical structures necessary for adequate functioning and significant aesthetic appearance of the hand. Autograft necrosis can be a significant disadvantage of thumb reconstruction based on free transplantation of the second toe using microsurgical anastomoses. It would either do everything or nothing. An experienced surgical team is essential [1, 4, 5, 6, 7, 9, 16, 17, 21, 33, 37]. Interpretation of long-term outcomes of treatment based on evidence-based medicine showed a paramount role of reconstructive surgery of the fingers in restoration of the thumb function and

appearance of the hand [1, 3, 5, 6, 9, 10, 16, 17, 20, 21, 23, 27, 32, 36].

Thus, the complexity of reconstructive operations on the thumb often pushes specialists to make a simpler decision and use methods of skin-bone reconstruction that do not suggest restoration of the joints of the new thumb and reconstruction of the hand grips and negatively affects functional aspects of the hand. Surgical treatment of patients with the thumb loss should be targeted at anatomical reconstruction of the thumb and restoration of the kinematics of hand movements with professional, household and social reintegration of patients. Optimization of treatment of patients with post-traumatic defects of the thumb based on transplantation of the second toe as an entity has important scientific and applied significance and is a promising trend.

CONCLUSION

Analysis of the available modern literature demonstrates that there is controversy in the choice of the type and timing of surgical treatment of patients with a lost thumb. The parameters to be evaluated at a long term of thumb reconstruction include reconstructive

anatomy and aesthetic appearance; restoration of the necessary amplitude of movements in the thumb joints, major grip types and the strength of the hand. Transplanting the second toe to the position of the missing thumb facilitated rapid recovery of the finger.

REFERENCES

- Adani R., Morandini E. Mikrokhirurgicheskaya rekonstruktsiya travmirovannogo bolshogo paltsa kisti [Microsurgical Reconstruction of the Injured Thumb]. *Voprosy Rekonstruktivnoi i Plasticheskoi Khirurgii*, 2013, vol. 16, no. 1 (44), pp. 6-19. (in Russian)
- Valeev M.M., Bolshakov R.E. *Sposob politizatsii kisti s travmaticheskim defektom pervogo lucha* [The way of politicizing the hand with a traumatic defect of the first ray]. RF Patent Application 2001100634, A 61 B 17/56, 2001. (in Russian)
- Gubochkin N.G., Gaidukov V.M., Mikitiuk S.I., Lukicheva N.P. *Sposob vosstanovleniya utrachennoy pervogo paltsa kisti* [The way of restoring the lost first finger of the hand]. Patent RF no. 2013156907/14, A 61 B 17/00, 2013. (in Russian)
- Wang H.D., Alonso-Escalante J.C., Cho B.H., DeJesus R.A. Versatility of Free Cutaneous Flaps for Upper Extremity Soft Tissue Reconstruction. *J. Hand Microsurg.*, 2017, vol. 9, no. 2, pp. 58-66. DOI: 10.1055/s-0037-1603918.
- Minasov B.Sh., Valeev M.M. Vosstanovlenie i formirovanie strukturno-funktsionalnykh stereotipov u bolnykh s defektom I paltsa kisti [Restoration and formation of structural and functional stereotypes in patients with a defect of the first finger of the hand]. *Travmatologiya i Ortopediya Rossii*, 2005, no. 3 (36), pp. 21-25. (in Russian)
- Novikov Iu.V., Kliuchevskii V.V., Pshenishnov K.P., Khodzhabagian Z.S. Replantatsiya i transplantatsiya kak metody vosstanovleniya otchlenennoi konechnosti ili ee segmentov [Replantation and transplantation as methods of restoring a detached limb or its segments]. *Voprosy Rekonstruktivnoi i Plasticheskoi Khirurgii*, 2016, no. 2 (57), pp. 63-73. (in Russian)
- Minasov B.Sh., Garapov I.Z., Valeev M.M., Biktasheva E.M., Iakupov R.R., Minasov T.B., Mavliutov T.R. Khirurgicheskoe lechenie patsientov s posttravmaticheskimi defektami pervogo paltsa kisti [Surgical treatment of patients with post-traumatic defects of the first finger of the hand]. *Uralskii Meditsinskii Zhurnal*, 2020, no. 4 (187), pp. 150-155. (in Russian)
- Roger de Oña I., Garcia Villanueva A., Studer de Oya A. An Alternative Thumb Reconstruction by Double Microsurgical Transfer from the Great and Second Toe for a Carpo-metacarpal Amputation. *J. Hand Surg. Am.*, 2018, vol. 43, no. 10, pp. 955.e1-955.e9. DOI: 10.1016/j.jhsa.2018.03.022.
- Valeev M.M., Garapov I.Z., Biktasheva E.M. Mikrokhirurgicheskii tekhnologii pri travmaticheskikh defektakh pervogo paltsa kisti [Microsurgical technologies for traumatic defect of the first finger of the hand]. *Kreativnaia Khirurgiya i Onkologiya*, 2019, vol. 9, no. 1, pp. 44-49. (in Russian)
- Azolov V.V., Aleksandrov N.M., Petrov S.V., Ruchkina E.V. Novye podkhody k rekonstruktsii paltsev kisti [New approaches to reconstruction of the hand fingers]. *Meditsinskii Almanakh*, 2010, no. 2 (11), pp. 194-198. (in Russian)
- Aleksandrov N.M., Kiselev D.V., Uglev O.I. Vosstanovlenie paltsev s ispolzovaniem krovosnabzhaemykh kozhno-kostnykh kompleksov u bolnykh s tiazhelymi posttravmaticheskimi deformatsiyami kisti [Restoration of fingers using blood-supplied skin-bone complexes in patients with severe post-traumatic deformities of the hand]. *Acta Medica Eurasica*, 2015, no. 4, pp. 1-9. (in Russian)
- Aleksandrov N.M., Petrov S.V. Kozhno-kostnaya rekonstruktsiya paltsev kisti s ispolzovaniem krovosnabzhaemykh transplantatov [Skin and bone reconstruction of the hand fingers using blood-supplied grafts]. *Sovremennye Tekhnologii v Meditsine*, 2011, no. 4, pp. 22-27. (in Russian)
- Naalla R., Chauhan S., Dave A., Singhal M. Reconstruction of post-traumatic upper extremity soft tissue defects with pedicled flaps: An algorithmic approach to clinical decision making. *Chin. J. Traumatol.*, 2018, vol. 21, no. 6, pp. 338-351. DOI: 10.1016/j.cjtee.2018.04.005.
- Aleksandrov N.M., Petrov S.V. Rekonstruktsiya paltsev kisti s ispolzovaniem traditsionnykh i mikrokhirurgicheskikh metodik [Reconstruction of the hand fingers using traditional and microsurgical techniques]. *Travmatologiya i Ortopediya Rossii*, 2010, vol. 16, no. 3 (57), pp. 111-117. (in Russian)
- Akdağ O., Yıldıran G., Sütçü M., Karamiş M. Posterior interosseous flap versus reverse adipofascial radial forearm flap for soft tissue reconstruction of dorsal hand defects. *Ulus. Trauma Acil. Cerrahi. Derg.*, 2018, vol. 24, no. 1, pp. 43-48. DOI: 10.5505/tjtes.2017.41196.
- Valeev M.M., Biktasheva E.M. Formirovanie pervogo paltsa kisti putem svobodnoi peresadki vtorogo paltsa stopy: Materialy Konf. «Problemye voprosy travmatologii i ortopedii» [Formation of the first toe by free grafting of the second toe: Materials of the Conf. "Problem Questions of Traumatology and Orthopaedics"]. *Zdravookhranenie Bashkortostana*, 2006, no. S2, pp. 139-142. (in Russian)
- Goliana S.I., Avdeichik N.V., Grankin D.Iu., Safonov A.V. Mikrokhirurgicheskaya autotransplantatsiya paltsev stopy na kist u detei [Microsurgical autotransplantation of toes on the hand in children]. *Sovremennye Problemy Nauki i Obrazovaniya*, 2019, no. 6, pp. 150. (in Russian)

18. Shvedovchenko I.V. Vrozhdennye poroki razvitiia kisti. Obshchie polozeniia mikrokhirurgicheskikh rekonstruktsii [Congenital malformations of the hand. General provisions of microsurgical reconstructions]. *Voprosy Rekonstruktivnoi i Plasticheskoi Khirurgii*, 2017, vol. 20, no. 1 (60), pp. 28-35. (in Russian) DOI: 10.17223/1814147/60/03.
19. Valeev M.M., Moiseev D.V., Chistichenko S.A., Faizov A.O., Prasad S.S., Valeeva E.M. Stabilnyi funktsionalnyi osteosintez perelomov kostei kisti: Materialy 2 Vseros. Sezda kistevykh khirurgov [Stable functional osteosynthesis of fractures of the hand bones: Materials of the II All-Russian Congress of the Hand Surgeons]. *Travmatologiya i Ortopediya Rossii*, 2008, no. S2 (Prilozhenie), pp. 15-16. (in Russian)
20. Garapov I.Z., Minasov B.Sh., Valeev M.M., Biktasheva E.M. Sravnitelnyi analiz esteticheskikh i funktsionalnykh rezultatov zakrytiia obshirnykh defektov pokrovnykh tkanei pervogo paltsa kisti [Comparative analysis of aesthetic and functional results of closure of extensive defects of the integumentary tissues of the first finger of the hand]. *Meditsinskii Vestnik Bashkortostana*, 2017, vol. 12, no. 1 (67), pp. 36-42. (in Russian)
21. Shvedovchenko I.V., Koltsov A.A. Peresadka paltsev stopy na kist u detei s vrozhdennoi i priobretennoi patologiei – osnovnye problemy i puti ikh resheniia [Transplantation of toes on a hand in children with congenital and acquired pathology – the main problems and ways to solve them]. *Annaly Plasticheskoi, Rekonstruktivnoi i Esteticheskoi Khirurgii*, 2017, no. 1, pp. 163-164. (in Russian)
22. Aleksandrov N.M., Petrov S.V., Kuptsov D.A., Petrov M.S. Rekonstruktsiia paltsev kisti s ispolzovaniem kozhno-kostnykh transplantatov na mikrososudistykh anastomozakh [Reconstruction of the hand fingers using skin-bone grafts on microvascular anastomoses]. *Sovremennye Tekhnologii v Meditsine*, 2020, vol. 12, no. 1, pp. 16-24. (in Russian)
23. Kurbanov U.A., Davlatov A.A., Dzhanobilova S.M. Osobennosti replantatsii i rekonstruktsii bolshogo paltsa kisti [Particular characteristics of replantation and reconstruction of the thumb]. *Vestnik Avitsenny*, 2012, no. 2 (51), pp. 7-20. (in Russian)
24. Valeev M.M., Garapov I.Z., Biktasheva E.M. Sposob politsizatsii kisti [The way of the hand pollicization]. *Ilizarovskie chteniia: Materialy Nauch.-prakt. Konf. s mezhdunar. uchastiem «Kostnaia Patologiya: ot teorii do praktiki», posviashch. 95-letiiu so dnia rozhdeniia G.A. Ilizarova, 65-letiiu metoda Ilizarova, 45-letiiu Tsentra Ilizarova* [Ilizarov Readings: Proceedings of the Scientific-practical. Conf. with int. participation "Bone pathology: from theory to practice", dedicated to 95th anniversary of the birth of G.A. Ilizarov, 65th anniversary of the Ilizarov method, 45th anniversary of the Ilizarov Centre]. Kurgan, 2016, pp. 87-88. (in Russian)
25. Segu S.S., Athavale S.N., Manjunath P. Osteoplastic Reconstruction for Post Traumatic Thumb Amputations around Metacarpophalangeal Joint. *J. Clin. Diagn. Res.*, 2015, vol. 9, no. 8, pp. PC11-13. DOI: 10.7860/JCDR/2015/14334.6404.
26. Malikov M.Kh., Artykov K.P., Karim-Zade G.D., Dzhononov D.D., Makhmadkulova N.A., Khasanov M.A. Ustranenie posttravmaticheskikh defektov pokrovnykh tkanei verkhnikh konechnostei [Elimination of post-traumatic defects of the integumentary tissues of the upper limbs]. *Plasticheskaya Khirurgiya i Esteticheskaya Meditsina*, 2020, no. 1, pp. 54-62. (in Russian)
27. Kutianov D.I., Rodomanova L.A. Sovremennye printsipy i tendentsii ispolzovaniia osevykh krovnosnabzhaemykh loskutov v rekonstruktivnoi khirurgii konechnostei [Modern principles and trends in the use of axial blood-supplied flaps in reconstructive surgery of the limbs]. *Travmatologiya i Ortopediya Rossii*, 2015, no. 1 (75), pp. 106-115. (in Russian)
28. Valeev M.M. *Meditsinskaya reabilitatsiya bolnykh s posledstviyami povrezhdenii verkhnei konechnosti na osnove khirurgicheskikh tekhnologii. Avtoref. diss. ... d-ra med. nauk* [Medical rehabilitation of patients with the consequences of the upper limb injuries based on surgical technologies. Dr. sci. diss. abstr.]. Ufa, 2006, 41 p. (in Russian)
29. Karim-Zade G.D., Malikov M.Kh., Ibragimov E.K., Narzillo Kh., Mirzobekov Kh.F., Makhmadkulova N.A. Korrektsiia miagkotkannykh defektov i posledstviy povrezhdeniya sosudisto-nervnykh puchkov verkhnikh konechnostei [Correction of soft tissue defects and the consequences of damaging the neurovascular bundles of the upper limbs]. *Vestnik Avitsenny*, 2018, vol. 20, no. 4, pp. 395-401. (in Russian)
30. Rodomanova L.A., Kochish A.Iu., Polkin A.G., Nakonechnyi D.G., Aksiuk E.F. *Sposob dvukhetapnoi peresadki paltsa stopy na kist* [The way of two-stage transplantation of a toe to a hand]. Patent RF 2345726 C1, A 61 B 17/56, 2007. (in Russian)
31. Berezutskii S.N., Chechurin A.S., Volovik V.E. Arterializirovannyye venoznye loskuty v rekonstruktivnoi khirurgii kisti i paltsev (obzor inostrannoi literatury) [Arterialized venous flaps in reconstructive surgery of the hand and fingers (Review of foreign literature)]. *Zdravookhranenie Dalnego Vostoka*, 2018, no. 4 (78), pp. 64-68. (in Russian)
32. Yoon W.Y., Lee B.I. Fingertip reconstruction using free toe tissue transfer without venous anastomosis. *Arch. Plast. Surg.*, 2012, vol. 39, no. 5, pp. 546-550. DOI: 10.5999/aps.2012.39.5.546.
33. Valeev M.M. Ispolzovanie avtovitalnykh loskutov u bolnykh s defektom miagkikh tkanei konechnostei [The use of autovital flaps in patients with soft tissue defects of the limbs]. *Zdravookhranenie Bashkortostana*, 2004, no. 6, pp. 67-80. (in Russian)
34. Andruson M.V. Kozhnaia plastika pri otkrytykh povrezhdeniyakh kisti i paltsev [Skin plastics for open injuries of the hand and fingers]. *Ortopediya, Travmatologiya i Protezirovaniye*, 2015, no. 4 (601), pp. 85-90. (in Russian)
35. Goliana S.I., Grankin D.Iu. Angioarkhitektonika sudov, pitaiushchikh autotransplantat vtorogo paltsa stopy, i varianty ikh «podklucheniia» k retsipientnym sudam pri peresadke na kist u detei [Angioarchitectonics of the vessels feeding the autograft of the second toe, and options for their "connection" to recipient vessels during transplantation on the hand in children]. *Sovremennye Problemy Nauki i Obrazovaniia*, 2018, no. 6, pp. 107. (in Russian)
36. Shibaev E.Iu., Ivanov P.A., Nevedrov A.V., Lazarev M.P., Vlasov A.P., Tsoglin L.L., Rybinskaia A.L. Taktika lecheniia posttravmaticheskikh defektov miagkikh tkanei konechnostei [Treatment tactics for post-traumatic soft tissue defects of the limbs]. *Zhurnal im. N.V. Sklifosovskogo. Neotlozhnaia Meditsinskaya Pomoshch*, 2018, vol. 7, no. 1, pp. 37-43. (in Russian)
37. Aleksandrov N.M., Kuptsov D.A., Vshaev I.D. Atipichnoe peremeshchenie segmentov kisti pri posledstviyakh travmy [Atypical movement of the hand segments for trauma consequences]. *Sovremennye Problemy Nauki i Obrazovaniia*, 2020, no. 5, pp. 137. (in Russian)
38. Minasov B.Sh., Valeev M.M., Nigamedzianov I.E., Zhukov A.Iu. Sotsialnaia, bytovaia i professionalnaia reintegratsiia bolnykh s defektami miagkikh tkanei na osnove funktsionalnoi i esteticheskoi reabilitatsii [Social, everyday and professional reintegration of patients with soft tissue defects based on functional and aesthetic rehabilitation]. Ufa, *Zdravookhranenie Bashkortostana*, 2005, 188 p. (in Russian)
39. Kim H.D., Hwang S.M., Lim K.R., Jung Y.H., Ahn S.M., Song J.K. Toe Tissue Transfer for Reconstruction of Damaged Digits due to Electrical Burns. *Arch. Plast. Surg.*, 2012, vol. 39, no. 2, pp. 138-142. DOI: 10.5999/aps.2012.39.2.138.

The article was submitted 12.05.2020; approved after reviewing 25.02.2021; accepted for publication 23.12.2021.

Information about authors:

1. Bulat Sh. Minasov – Doctor of Medical Sciences, Professor, B.minasov@ya.ru;
2. Ilmur Z. Garapov – M.D., dr.elinabiktasheva@yandex.ru;
3. Elina M. Biktasheva – Candidate of Medical Sciences, dr.elinabiktasheva@yandex.ru;
4. Marat M. Valeev – Doctor of Medical Sciences, valeevmm@rambler.ru;
5. Rasul R. Iakupov – Doctor of Medical Sciences, rasulr@mail.ru;
6. Timur B. Minasov – Doctor of Medical Sciences, m004@yandex.ru;
7. Tagir R. Mavliutov – Doctor of Medicine, mavliutovtagir@mail.ru.