

MPHTI 76.29.39

# LONG-TERM CONSEQUENCES OF THE HAND SOFT TISSUE INJURIES. (REVIEW)

**Baimakhanov B. B.**

orcid.org/0000-0003-0049-5886

**Nabiev E. N.**

orcid.org/0000-0002-1532-8151

**Kazantayev K. E.**

orcid.org/0000-0002-3566-8719

**Turdaliev B. C.**

orcid.org/0000-0003-4111-6440

**Mukhamedkerim K. B.**

orcid.org/0000-0002-4343-0743

**Muradov M. I.**

orcid.org/0000-0002-9168-8618

**Koshkarbayev D. Zh.**

orcid.org/0000-0001-8158-1334

**Corresponding author:****Kazantayev K. E.** – 1st year PhD

student at "Asfendiyarov Kazakh

National Medical University" NC JSC.

E-mail: kimbax@mail.ru

**Conflict of interest**

The authors declare that they have no conflicts of interest

**Keywords**

hand surgery, trauma consequences, hand tissue defects, microsurgery

**Baimakhanov B. B.<sup>1</sup>, Nabiev E. N.<sup>2</sup>, Kazantayev K. E.<sup>2</sup>, Turdalieva B. C.<sup>3</sup>, Mukhamedkerim K. B.<sup>3</sup>, Muradov M. I.<sup>1</sup>, Koshkarbayev D. Zh.<sup>1</sup>**

<sup>1</sup>«A.N. Syzganov National Scientific Center for Surgery» JSC, Almaty, Kazakhstan

<sup>2</sup>«Asfendiyarov Kazakh National Medical University» NC JSC, Almaty, Kazakhstan

<sup>3</sup>«Kazakh Medical University of Continuing Education» JSC, Almaty, Kazakhstan

**Abstract**

Today hand surgery is of more concern to many surgeons, due to in everyday practice, issues related to upper limb injuries and their consequences require solving practical problems, a professional approach, microsurgical skills.

The aim of this work is to analyze the literature data on hand injuries consequences and hand tissue defects.

**Material and methods.** We conducted a systematic search of literature data and selected sources from the databases of Cochrane, Google Scholar, PubMed, Elibrary, as well as research papers and educational online publications in English, Russian and Kazakh. Forty papers were included that met the inclusion criteria.

**Results.** The review article describes the causes of hand injuries consequences, as well as the treatment of this pathological condition.

**Conclusions.** Thus, today there is a tendency towards an increase in the consequences of upperlimbs tendons injuries, there are a number of reasons contributing to this: the territorial peculiarity of our Republic, low awareness about the existence of hand surgery among the population. After analyzing of reviewed information, we came to the conclusion that even at the initial visit, patients with hand tendon injuries should receive specialized care.

## Қолдың жұмсақ тіндері жарақаттарының алшақ салдары. (Әдебиет шолуы)

**Баймаханов Б.Б.<sup>1</sup>, Набиев Е.Н.<sup>2</sup>, Қазантаев Қ.Е.<sup>2</sup>, Турдалиева Б.С.<sup>3</sup>, Мухамедкерим Қ.Б.<sup>3</sup>, Мурадов М.И.<sup>1</sup>, Қошкарбаев Д.Ж.<sup>1</sup>**

<sup>1</sup>«А.Н. Сызғанов атындағы Ұлттық ғылыми хирургия орталығы» АҚ, Алматы қ., Қазақстан

<sup>2</sup>«С.Ж. Асфендияров атындағы Қазақ Ұлттық медицина университеті» КеАҚ, Алматы қ., Қазақстан

<sup>3</sup>«Қазақ медициналық үздіксіз білім беру университеті» АҚ, Алматы қ., Қазақстан

**Корреспонденция үшін автор:****Қазантаев Қ.Е.** –

«С.Ж. Асфендияров атындағы Қазақ

Ұлттық медициналық университеті»

КеАҚ, 1 курс докторанты.

E-mail: kimbax@mail.ru.

**Мүдделер қақтығысы**

Авторлар мүдделер қақтығысының жоқтығын мәлімдейді

**Аңдатпа**

Бүгінгі таңда қол хирургиясына көптеген хирургтар қызығушылық танытады, өйткені күнделікті практикалық қызметтегі қолдың жарақаттарына және олардың салдарына байланысты мәселелер кәсіби тәсілдерді, микрохирургиялық дағдыларды, практикалық мәселелердің шешімін талап етеді.

**Жұмыстың мақсаты** - қол жарақаттары мен қол тіндері ақауларының салдары туралы әдеби мәліметтерді талдау.

**Материал және әдістер.** Біз Cochrane, Google Scholar, PubMed, Elibrary мәліметтер базасынан, сондай-ақ зерттеу жұмыстарынан және ағылшын, орыс және қазақ тілдеріндегі онлайн оқу-әдістемелік онлайн басылымдардан әдеби мәліметтерге жүйелік іздеу жүргізіп, дереккөздерді іріктеп алдық. Қосу критерийлеріне сәйкес келетін қырық жұмыс іріктелді.

**Нәтижелер.** Шолу мақаласында қол буыны жарақаттарының салдарының туындау себептері, сондай-ақ осы патологиялық жағдайды емдеу жолдары сипатталған.

**Қорытынды.** Осылайша, бүгінгі таңда қол сіңірлері жарақаттарының салдарларының өсу тенденциясы байқалады, бұған бірқатар себептер әсер етеді: біздің республикамыздың аумақтық ерекшелігі, тұрғындардың қол буыны хирургиясы туралы жеткіліксіз деңгейде хабардар болуы. Біз қаралған мәліметтерді талдай отырып, қол сіңірлерінің жарақаттары бар науқастар дәрігерге бастапқы жүгіну кезінде оларға мамандандырылған көмек көрсетілуі керек деген қорытындыға келдік.

**Түйін сөздер**

қол хирургиясы, жарақат салдары, қол тіндерінің ақаулары, микрохирургия

## Отдаленные последствия травм мягких тканей кисти. (Обзор литературы)

**Баймаханов Б.Б.<sup>1</sup>, Набиев Е.Н.<sup>2</sup>, Казантаев К.Е.<sup>2</sup>, Турдалиева Б.С.<sup>3</sup>,  
Мухамедкерим К.Б.<sup>3</sup>, Мурадов М.И.<sup>1</sup>, Кошкарбаев Д.Ж.<sup>1</sup>**

<sup>1</sup>АО «Национальный научный центр хирургии им. А.Н. Сызганова», г. Алматы, Казахстан

<sup>2</sup>НАО «Казахский Национальный медицинский университет имени С.Д. Асфендиярова»,  
г. Алматы, Казахстан

<sup>3</sup>АО «Казахский медицинский университет непрерывного образования», г. Алматы, Казахстан

**Автор для корреспонденции:**  
**Казантаев К.Е.** – докторант 1-курса  
НАО «Казахский Национальный  
Медицинский Университет им.  
С.Д. Асфендиярова».  
E-mail: kimbasx@mail.ru

**Конфликт интересов**  
Авторы заявляют об отсутствии  
конфликта интересов

### Аннотация

Хирургия кисти, на сегодняшний день, вызывает интерес у многих хирургов, так как в повседневной практической деятельности, вопросы касающиеся травм верхних конечностей и их последствия, которые требуют решение практических проблем, профессионального подхода, микрохирургических навыков.

**Целью данной работы** является анализ литературных данных на тему последствий травм кисти и дефектами тканей кисти.

**Материал и методы.** Мы провели систематический поиск литературных данных и отобрали источники из базах данных Кокрейна, Google Scholar, PubMed, Elibrary а также исследовательские работы и учебные онлайн-издания на английском, русском и казахском языках. Были включены сорок работ, которые удовлетворяли критериям включения.

**Результаты.** В обзорной статье приведены причины возникновения последствий травм кисти, а также лечение данного патологического состояния.

**Выводы.** Таким образом, на сегодняшний день отмечается тенденция роста последствий травм сухожилий верхних конечностей, имеются ряд причин способствующих этому: территориальная особенность нашей Республики, низкая осведомленность среди населения о существовании хирургии кисти. После анализа просмотренной информации мы пришли к выводу, что еще на первичном обращении пациенты с травмами сухожилий кисти должны получить специализированную помощь.

### Ключевые слова

хирургия кисти, последствия травм, дефекты тканей кисти, микрохирургия

The human hand, as an executive organ, is at the center of daily activities in various professions and in sports. And due to its prominent position, the hand is always prone to injury and overuse.

Even with the society changing from an industrial society to a service-based society, surprisingly, the supposed reduction in hand injuries has never happened [1].

The aim of this work is to analyze the literature data on the consequences of hand injuries and hand tissue defects.

### Materials and methods

We conducted a systematic search of literature data and selected sources from the databases of Cochrane, Google Scholar, PubMed, Elibrary, as well as research papers and educational online publications in English and Russian, Kazakh. Twenty papers were included that met the inclusion criteria.

#### Inclusion criteria

We included 30 sources that met our inclusion criteria: studies that were conducted in patients with the sequelae of hand injuries, sources published no later than 10 years.

#### Validation and Data Extraction

We evaluated a sample of 10 sources in which attention was paid to the consequences of hand injuries and from 20 sources on hand tissue defects.

The articles were analyzed in a random order based on key aspects. Data elements taken for this article included: study design, sampling method, number of patients and operations performed, definition of outcome, clinical observations, review articles.

### Results

According to foreign authors, on the basis of 50,272 injured[2].

28.6% of patients receiving emergency care were patients with a hand injury. On average, hand injuries account for 14% to 30% of all emergency patients.

Tendon injuries are in 2nd place (29%), while fractures are in 1st place (42%), and skin lesions are in 3rd place among all patients treated for hand injuries. Although only 2% of patients are hospitalized, hand injuries, especially tendon injuries, play a key role in orthopedic and traumatic management.

Based on the analysis of the situation carried out by the authors and M.I. Muradov on the basis of JSC "A.N. Syzganov National Scientific Center for Surgery "[2,3,4] in the department of reconstructive-plastic and aesthetic microsurgery, which has the status of Republican significance, which facilitated the referral of patients from all regions of the country.

On average, 420 patients are operated on the hand tendon injuries consequences annually, and the following organizational, diagnostic, tactical and technical mistakes were made in the primary treatment of patients with hand injury:

- I) Late referral of patients to a specialized hospital
- II) Lack of microsurgical techniques in the primary restoration of the anatomical structures of the hand;
- III) Application of inappropriate suture material;
- IV) Failure to comply with the rules of surgical approaches to the hand and inadequate skin grafting;
- V) Immobilization of the hand and fingers in a functionally disadvantageous position.

All this explained the long periods of incapacity and the high level of disability with finger injuries.

At the same time, a discrepancy was revealed between the territorial remoteness of cities from the Center. The time from injury to hospitalization ranged from 2 weeks to 12 years. This indicates a low awareness of doctors about the need to treat this group of patients in a specialized departments [5,6,7].

Today, specialists working in hand and plastic surgery field are convinced that plastic surgery with a full flap or split skin graft is indicated in cases where there is superficial damage to the hand and fingers without exposing functionally important anatomical structures [8,9,10,11]. A prerequisite for free skin grafting is a good blood supply to the recipient bed, well-supplied fiber, or healthy granulation. Even if these conditions are met, failures are frequent - partial and complete necrosis of skin grafts [12, 13]. A free skin graft is not uncommon, it also grows together with the underlying tissues, scleroses, becomes thinner, and easily ulcerates. Also, its area decreases, especially on the palmar surface of the hand, which leads to flexion contractures of the hand and fingers. The scar tissue formed after deep burns grows together directly with the bones of the phalanges and their articular surfaces. In such conditions, split or full-thickness skin grafts do not take root well, but even with successful plastic surgery, a skin resistant to injury is not created. In addition, they cannot cover tendons, nerves, joints [14,15]. Also, at the height of retraction, the area of the graft can be halved. Recovery of sensitivity on a free skin graft is unpredictable and never occurs to a satisfactory level [15]. A large number of methods of plastic surgery on the hand with local tissues are known, which do not require immobilization and use the skin with the closest properties. Here, flaps on wide bases and on neurovascular pedicles from areas close to the defect are possible. The first includes flaps from the elevation of 1 finger in various modifications, which are used

when it is necessary to close at the tip of one finger or amputation wound on the stump. For the repair of defects on the palmar surface of the fingers, cross-repair with flaps from the dorsum of the adjacent finger is successfully used. Local flaps on the neurovascular pedicle, in contrast to "arbitrary", guarantee blood supply and innervation. These flaps are larger in size, sensitive, mobile, and therefore are used most often to eliminate defects and restore sensitivity on the supporting surfaces of the thumb and index finger. Obviously, local plastic surgery of the hand is possible only with small hand defects, mainly on the fingers, and causes some damage to an already damaged hand. Extensive exposure of tendons, nerves, bones, joints of the hand as a result of trauma or excision of scars requires plasty with a blood-supplied flap containing subcutaneous tissue. The choice of a flap for plasty of defects on the hand depends on the shape, localization, depth of the defect, but, as a rule, it is limited to different variants of the Italian and Filatov flap. As a donor site for a pedicle flap, the skin of the anterior surface of the chest or anterior abdominal wall is most often used. Cutting out flaps on a pedicle on an intact arm has its advantages due to the thinner skin, its high capacity for functional restructuring, however, the inconveniences associated with the patient's position and his emotional state, significantly limit the use of this modification [16]. The overwhelming majority of specialists in hand surgery consider the use of a sharp Filatov stem as the method of choice for scalped wounds of the fingers. Bur'yanov A.A. et al. [17] negatively assess the cosmetic effect of stem plasty and recommend making «pocket plasty» with full scalping of one finger. Pocket plastic and plastic with double flaps are shown when scalping several fingers and scalping the hand in a "glove" manner. Modifications of flaps with closed pedicle flaps have been proposed. Known "funnel-shaped flap", pedicle flap taken under the mammary gland [18]. They combine the features of flap and pocket plastics. The feasibility of cutting out flaps in women under the mammary gland is questionable both from a cosmetic point of view and in connection with possible complications. According to O.N. Milanov, an indication for plastic surgery with a "sharp" Filatov stem is a circular defect in the soft tissues of the fingers, for plastic surgery according to Holevich - skin defects on the dorsum or palmar surface of the hand, as well as the stump of the hands during amputation of fingers. «Pocket plastic» was used for circular defects of the finger skin and for the so-called glove type injuries of the hand. The author noted that while using this plasty, difficulties arise when closing the abdominal wound (for plastic purposes, the abdominal skin was mainly used) and the formation of the

skin on the hand after its separation, especially with extensive defects. The terms of treatment increased due to additional plastic interventions. The use of pedicle flaps is indicated to preserve the length and function of 1 finger in cases of soft tissue necrosis of this finger. Some authors have obtained positive results when using non-free skin grafting for the treatment of osteomyelitis of the hand and fingers [19]. Italian and round stems are mobilized without taking into account the course of skin vessels, which, as a rule, do not contain the main artery and nerve. These factors cause a large number (36-45%) of various complications, including suppuration, osteomyelitis, trophic ulcers of the grafts. A.A. Gritsyuk and S.N. Rybakov noted complications with non-free skin grafting in 28.8%, of which partial necrosis - 15.8%, marginal necrosis - in 9.5% and suppuration - in 3.5%. Extensive and total necrosis was not observed. The degree of blood circulation and innervation of these flaps does not reach the normal level inherent in the skin of the hand, and the restoration of such sensitivity can be expected from 6 months to 2 years after surgery [20]. The disadvantages associated with reduced blood circulation in a flap taken without taking into account the course of skin vessels (the so-called "arbitrary" flap) do not have flaps based on permanent cutaneous arterial lines, such as the superficial epigastric artery, the superficial artery that envelops the iliac bone, superficial pudendal artery [21]. The introduction of the microsurgical method in the restoration, reconstruction and plastics of the hand with the use of flap surgery remains the method of choice. For more than 10 years, the transplantation of tissue complexes has made it possible to eliminate tissue defects in a short time, restoring the normal layer-by-layer structure of the injured area, with full functional and cosmetic rehabilitation. In recent years, in the treatment of injuries of the musculoskeletal system, the method of autotransplantation of vascularized tissues, which is used to replace the skin, muscles, and bone, has become increasingly widespread. Such "microvascular" flaps have high vascularization, and their simultaneous transplantation allows replacing defects regardless of the location, size and nature of the lesion. Combined microvascular grafts are successfully used in clinical practice, which make it possible to close large defects in the area and depth of the lesion. However, the exceptional technical complexity, requiring special equipment and training of surgeons, the considerable duration and severity of the operation for the patient, significantly limit the application of this method. There is a high risk of secondary deformation of the donor area and postoperative thrombosis with subsequent flap necrosis [22]. N.S. Niranjana, with considerable

experience in free transplanting, warns against often overlooked shortcomings. There is always a danger of death of the transplanted tissue ("all or nothing"). These operations are time-consuming, labor-intensive and can be performed with two specialized teams of surgeons and well-equipped centers. At the Atlanta Medical Center, the largest medical institution in the United States with a high-class microsurgical service, D. Fasano reviewed the clinical material. It was reported that serious complications during plastic surgery with vascularized flaps were observed in 43.1% of patients after microsurgical operations. Complete flap loss was 13.3% of cases; partial - in 6.9% of cases. In 5.2%, complications were noted in the donor area (most often, suppuration, sub-flap hematomas). A.E. Belousov reports various complications in 25 out of 82 patients (30.4%) during transplantation with free complex-composite flaps on microvascular anastomoses, and a complete failure of transplantation of 7 (8%) grafts out of 87. Autotransplantation of blood-supplied tissues is considered indicated only when a specific the surgical task cannot be solved effectively enough in another, simpler way. The most common use in hand surgery is the use of a radial flap. The radial artery, which forms a deep palmar arch on the hand, is located in the lateral intermuscular septum between mm. brachioradialis and flexor carpi radialis, giving off 9-17 branches along their course, going to the fascia of the forearm. Most of the branches extend from the radial artery in the distal third of the forearm. These numerous branches form a dense fascial network that provides perfusion to the entire forearm skin. In view of this, the forearm flap is skin-facies. In addition to the radial artery, which is the main source of blood supply to the skin of the forearm, perfusion is provided by the ulnar artery, anterior and posterior interosseous arteries. According to a clinical study performed by Kerawala, the mean arterial return pressure in the distal part of the radial artery is 40 mm Hg. Thus, after the flapsampling, the blood supply to the hand does not suffer, however, rare cases of ischemia of the hand after grafting the flap or due to vascular anomalies: duplication of the radial artery and others have been described [23]. A large number of unnamed branches of the radial artery to the skin, muscles and periosteum make it possible to perform flap grafting of various designs. Transposition of the entire skin of the forearm on the vascular pedicle, represented only by the radial artery, is possible, for example, during amputation of the upper limb. Song and Gao note that all cutaneous branches run along the fascia of the forearm, and most of them in the distal forearm run between mm. brachioradialis and flexor carpi radialis. In view of this, the fascia can be included in the composi-

tion of the flap along its lower surface. Bone nutrition is provided by periosteal and directly bone branches, perforating m. flexor pollicis longus and anastomosed with the medullary vascular system. Venous outflow from the forearm flap is provided by the deep radial vein or superficial veins, which form many anastomoses with each other. Due to the many variations in the anatomy of the deep and superficial veins, the decision about which vein should be included in the vascular pedicle is an individual decision. Although the diameter of the superficial veins is large enough, which greatly facilitates anastomosis, with a small area of the skin cushion, as well as in cases of hidden damage to the intima of the vessel (for example, with repeated catheterizations of the forearm veins and intravenous infusions), the use of these veins is undesirable. When examining the volume of blood flow using Doppler sonography, it was found that during flap transplantation, the outflow through the deep veins is significantly greater. Despite the presence of valves in both the superficial and deep veins, retrograde blood flow is possible due to the numerous intermediate veins, which makes it possible to harvest the flap on the distal vascular pedicle, which can be very useful in closing hand defects. The radial flap is thin, flexible and mostly hairless. The skin-facies arrangement allows it to be used when replacing hand defects. Large vascular diameter (artery 2-3 mm, v. Cephalica - 3-4 mm, deep veins - 1-3 mm), long vascular pedicle and many options for flap perfusion (ortho- or retrograde, venous outflow along superficial or deep veins) greatly facilitate the work of the surgeon. During the reconstruction of head and neck region defects, for example, during resection of a tumor of this localization, it is possible to simultaneously harvest the flap by the second surgical team, which significantly reduces the duration of the surgical intervention. In addition to these advantages, it is necessary to point out the disadvantages of the flap. Since grafting of the flap implies a complete cessation of blood flow in the distal segment of the radial artery, the blood supply to the hand is provided only by the ulnar artery and the remaining anterior and posterior interosseous branches. In a study of 750 corpses, it was found that the radial and ulnar arteries were present in all cases, and the blood supply to the hand was mainly provided by the ulnar artery ending in the superficial palmar arch. Despite this, in some cases, blood supply to the thumb and index fingers can be provided only by the radial artery: for example, in the absence of branches to these fingers from the superficial palmar arch (option 1) or in the absence of anastomosis between the superficial and deep palmar arch (option 2). In order to prevent the development of postoperative ischemia of the hand, it is

necessary to perform the Allen test, or, in doubt, an angiographic study. Porter described a case of the absence of the radial artery, when the blood supply to the forearm is provided by the codominant median and ulnar arteries. A significant disadvantage is the appearance of the donor site after the graft harvest. The patient often has to avoid wearing short sleeves for aesthetic reasons. There is a fairly large number of publications that report a 30–50% incidence of complications at the donor site, most of which are necrosis of a split skin autograft [24]. To reduce the morbidity of the donor site, a large number of techniques have been proposed that make it possible to perform the primary closure of the donor area: VY-shaped plastic surgery, plastic surgery with local flaps, and the use of expanders. To improve the properties of the skin autograft, McGregor suggested immobilizing the limb in the wrist extension position for 20 days. In addition to problems with the healing of the donor site, there are other complications such as edema, decreased grip strength, limited extension in the wrist joint, decreased sensitivity due to damage to the branches of the radial nerve, and decreased cold tolerance. Despite the fact that the flap is traditionally considered the “workhorse” of reconstructive hand surgery, the listed disadvantages limit its scope and may persuade both the surgeon and the patient to choose another flap. Alternative methods with less morbidity of the donor site, for example, perforating flaps, can be successfully used for the reconstruction of soft tissue defects with practically the same indications as for the radial forearm flap.

## Conclusion

The introduction of microsurgery methods into clinical practice has significantly expanded the possibilities of organ-saving therapeutic tactics, opened up real prospects for reducing the level of disability among this large and socially significant group of patients [25]. At the same time, hand injuries tend to increase in severity, taking on the nature of multiple and combined [26,27,28]. In this regard, complex tactical issues arise related to the contradictions between the desire for the most complete restoration of all damaged structures and a critical assessment of the functional prospects of the restored fingers and hand as a whole [29,30].

After analyzing the reviewed information, we came to the conclusion that the increased requirements for the quality of life, the tendency to an increase in the frequency of multiple, combined injuries of the hand, dictate the need to search for new methods, revise and improve existing organizational approaches and microsurgical treatment of this category of patients.

## References

- Angermann P, Lohmann M. Injuries to the hand and wrist. A study of 50,272 injuries. *J Hand Surg Br.* 1993 Oct;18(5):642-4. doi: 10.1016/0266-7681(93)90024-a. PMID: 8294834.
- Howell, J. W., Merritt, W. H., Robinson, S. J.: Immediate controlled active motion following zone 4–7 extensor repair. *J. Hand Ther.* 2005, 18, 182–190.
- Muradov M.I., Muhamedkerim K.B., Sadykov T.A. Analiz sostojanija hirurgii kisti v Kazahstane. [Muradov M.I., Mukhamedkerim K.B., Sadykov T.A. Analysis of the state of hand surgery in Kazakhstan] *Bulletin of Surgery of Kazakhstan.* 2015. No. 1. Pages 53-56. (in Russian)
- Cuadra, A., Correa, G., Roa, R., et al.: Functional results of burned hands treated with Integra. *J. Plast. Reconstr. Aesthet. Surg.*, 2012, 65, 228–234.
- Rashid M., Hussain S.S., Aslam R., et al. A comparison of two fasciocutaneous flap in the reconstruction of defects of the weight-bearing heel // *J. Coll. Physicians Surg. Pac.* - 2003. - Vol.13., №4. - P. 216-218.
- Weigert, R., Choughri, H., Casoli, V.: Management of severe hand wounds with Integra® dermal regeneration template. *J. Hand Surg. Eur.*, 2011, 36, 185–193. 5. Komarov A.S.,
- Amornvit P, Rokaya D, Keawcharoen K, Raucharernporn S, Thongpulsawasdi N. One- vs two stage surgery technique for implant placement in finger prosthesis // *J ClinDiagn Res.* – 2013. - №7(9). – P. 1956-1968.
- Munenchi J. Nonmicrosurgical replantation using a subcutaneous pocket for salvage of the amputated fingertip // *J. Hand Surg.* - 2005. - Vol. 30., №3. - P. 562-565.
- Marec C.A., Pu L.L. Refinements of free tissue transfer for optimal outcome in lower extremity reconstruction // *Ann. Plast. Surg.* - 2004. - Vol. 52., №3. - P. 270-275.
- Landin L. Transplantation and surgery of the hand // *Ann Plast Surg.* – 2014. - №72(1). - P. 1-6.
- Khandwala, A. R., Webb, J., Harris, S. B., et al.: A comparison of dynamic extension splinting and controlled active mobilization of complete divisions of extensor tendons in zones 5 and 6. *J. Hand Surg. Eur.*, 2000, 25, 140–146.
- Ivanov V.E., Prusakov V.A., Pinskiy G.S. Kontrol' zhiznesposobnosti mikrohirurgicheskikh autotransplantatov v rannem posleoperacionnom periode. [Ivanov V.E., Prusakov V.A., Pinsky G.S. Monitoring the viability of microsurgical autografts in the early postoperative period] // *MRZh.* - 1990. - No. 4. - S. 19-26. (in Russian)
- Musharafieh R., Atiyeh B., Macari G et al. Radial forearm fasciocutaneous free-tissue transfer in ankle and foot reconstruction: review of 17 cases // *J. Reconstr. Microsurg.* - 2001. – Vol.17., №3. - P. 147-150.
- Lineaweaver W., Huik K., Jim K. et al The role of the plastic surgeon in the management of surgical infection // *Plast. Reconstr. Surg.* – 1999. - Vol.103. - P.1553-1561.
- Bíró, V.: The application of the dynamic splinting in the postoperative rehabilitation of extensor tendon injuries. [Dinamikus sínézés alkalmazása a feszítőin-sérülések posztoperatív rehabilitációjában.] *Rehabilitáció*, 2013. In press. [in Hungarian]
- Brown, J. M., Tung, T. H., Mackinnon, S. E.: Median to radial nerve transfer to restore wrist and finger extension: technical nuances. *Neurosurgery*, 2010, 66 (Suppl. 3), 75–83.
- Amornvit P, Rokaya D, Keawcharoen K, Raucharernporn S, Thongpulsawasdi N. One- vs two stage surgery technique for implant placement in finger prosthesis // *J ClinDiagn Res.* – 2013. - №7(9). – P. 1956-1968.
- Bertelli, J. A., Ghizoni, M. F.: Very distal sensory nerve transfers in high median nerve lesions. *J. Hand Surg. Am.*, 2011, 36, 387–393.
- Thordarson D.B. Congenital crossover fifth toe correction with soft tissue release and cutaneous Z-plasty // *Foot. Ankle.Int.* - 2001. - Vol. 22, №6. - P. 511-512.
- Breidenbach, W. C., Tobin, G. R., Gorantla, V. S., et al.: A position statement in support of hand transplantation. *J. Hand Surg. Am.*, 2002, 27, 760–770.
- Weir R., Heckathorne C., Childress D. Cineplasty as a control input for externally powered prosthetic components // *J.Rehabil. Res. Dev.* - 2001. - Vol.38., №4. - P. 357-363.
- Edgell, S. E., McCabe, S. J., Breidenbach, W. C., et al.: Different reference frames can lead to different hand transplantation decisions by patients and physicians. *J. Hand Surg. Am.*, 2001, 26, 196–200.
- Dubernard, J. M., Owen, E., Herzberg, G., et al.: Human hand allograft: report on first 6 months. *Lancet*, 1999, 353, 1315–1320
- Lovett W. L., McCallu M. Nerve Injuries: Management and Rehabilitation // *Orthop. Clin. North Am.* - 1983. - Vol. 14, №4. -P. 767- 778.
- Leddy J.P. Flexor Tendon - Acute Injuries // *Operative Hand Surgery.* - Churchill Livingstone: 1993. - P. 1823-1851.
- Bíró, V.: Recent viewpoints in postoperative rehabilitation of the flexor tendon injuries of the hand. [Újabb szempontok a kézhajlítóin-sérüléseinek posztoperatív gyógytornakezelésében.] *Rehabilitáció*, 2012, 22, 8–15. [in Hungarian]
- Saratov Journal of Medical Scientific Research. 2009. Vol.5. № 3. O.V. Beidik., A.V. Zaretskov., M.A. Shcherbakov. Surgical treatment of patients with multitrauma of fingers, 407p.
- Adolfsson L., Soderberg G., Larsson M., Karlander L. E. The effects of a shortened postoperative mobilization programme after flexor tendon repair in zone 2 // *J. Hand Surg.* - 1996. - Vol. 21 B, №1. - P. 67-71.
- S. Coppolino, F. Lupo, F. Quatra, M. R. Colonna, T. Merrino, F. Ruggeri, G. Risitano. Surgery and rehabilitation of flexor tendons injuries in zone 1 and 2. *Minerva Chir.* 2003. Feb. №58(1):P. 93-96.
- Alderman AK, Collins ED, Streu R, et al. Benchmarking outcomes in plastic surgery: national complication rates for abdominoplasty and breast augmentation. *Plastic and Reconstructive Surgery.* 2009 Dec;124(6):2127-2133. DOI: 10.1097/prs.0b013e3181bf8378.