

Журнал «Перспективи та інновації науки»
(Серія «Педагогіка», Серія «Психологія», Серія «Медицина»)
№ 11(57) 2025

UDC 617.57-001.5-089:615.8

[https://doi.org/10.52058/2786-4952-2025-11\(57\)-2672-2684](https://doi.org/10.52058/2786-4952-2025-11(57)-2672-2684)

Kyrychenko Vasyl' Ivanovych associate professor of the traumatology and orthopedics Department, National Pirogov Memorial Medical University, Vinnytsia, <https://orcid.org/0000-0002-8267-5823>

Kyrychenko Yuri Vasylovych associate professor of the sports medicine, physical education and rehabilitation Department, National Pirogov Memorial Medical University, Vinnytsia, <http://orcid.org/0000-0002-7945-8983>

Horodetska Oleksandra Oleksandrivna associate professor of the sports medicine, physical education and rehabilitation Department, National Pirogov Memorial Medical University, Vinnytsia, <http://orcid.org/0000-0002-7483-2155>

Dus Sergey Valeriyovych senior lecturer of the sports medicine, physical education and rehabilitation Department, National Pirogov Memorial Medical University, Vinnytsia, <http://orcid.org/0000-0002-9865-8301>

Bandurka Natalia Mykolaivna associate professor of the Physiology Department, National Pirogov Memorial Medical University, Vinnytsia, <http://orcid.org/0000-0002-4317-9958>

MODERN ASPECTS OF REHABILITATION AFTER UPPER LIMB AMPUTATION

Abstract. Recovery following upper-limb amputation is one of the most demanding problems in modern medicine, resulting in lifelong disability, reduced quality of life and loss of social and vocational engagement. An increasing burden of trauma, industrial and household accidents, as well as war and blast injuries, continues to raise the proportion of upper-limb amputations, adding extra pressure on health-care and rehabilitation systems. However, there is wide variation in access to prosthetic and rehabilitation services, and high rates of prosthesis rejection together with substantial psychological morbidity highlight the importance of systematically reviewing the available evidence on contemporary rehabilitation. This review aimed to explore the current status of rehabilitation methods and opportunities for people following upper-limb amputation. A narrative review of recent scientific literature indexed in PubMed and Google Scholar was carried out, using keywords related to upper-limb amputation, prosthetic rehabilitation, mental health and social reintegration. The literature consistently reports that optimal rehabilitation is phased, long term and multidisciplinary, encompassing medical and nursing care, prosthesis fitting and training in its correct

use, as well as structured psychiatric and psychological support to improve activities of daily living, pain control and overall quality of life. The needs of patients clearly extend beyond restoring voluntary motor control and include the management of phantom and residual limb pain, learning one-handed self-care, adapting home and work environments, provision of social and financial support and active family involvement, all of which strongly influence reintegration and long-term prosthesis use. Neurorehabilitation techniques that have shown potential for reducing phantom limb pain and improving prosthesis control include mirror therapy, virtual reality, motor imagery, robotic systems and brain-computer interfaces; however, the evidence base is still limited by small sample sizes and a paucity of robust randomised controlled trials. Clinical guidelines, particularly those developed in veteran and defence health-care systems, support a pre-prosthetic phase, prosthesis prescription and provision, intensive functional training and long-term follow-up, but their applicability is constrained in resource-limited environments, and upper-limb-specific recommendations remain incomplete. Outcome assessment is further limited by heterogeneous and only partially validated measures; at the same time, sensor-based monitoring has demonstrated “learned non-use” of the prosthetic limb, large individual variability in the comparative benefits of body-powered versus myoelectric devices and high abandonment rates related to discomfort, reduced functionality, technical issues and unmet expectations. Evidence also indicates that successful social and vocational reintegration requires early psychological assessment, rehabilitation tailored to amputation level and functional goals, access to vocational rehabilitation and employer support, while children and young people are particularly at risk of major long-term psychosocial sequelae in the absence of dedicated educational and rehabilitation programmes. In conclusion, rehabilitation following upper-extremity limb loss should be regarded as a long-term, context-adapted, multidisciplinary process, and more rigorous research together with implementation and localisation of international guidelines is warranted to optimise functional, psychological and social outcomes.

Keywords: upper limb amputation, postoperative rehabilitation, upper limb prosthetics, physical therapy, occupational therapy, quality of life of patients.

Кириченко Василь Іванович доцент кафедри травматології та ортопедії Вінницького національного медичного університету ім. М. І. Пирогова, м. Вінниця, <https://orcid.org/0000-0002-8267-5823>

Кириченко Юрій Васильович доцент кафедри спортивної медицини, фізичного виховання та реабілітації Вінницького національного медичного університету ім. М. І. Пирогова, м. Вінниця, <http://orcid.org/0000-0002-7945-8983>

Городецька Олександра Олександрівна доцент кафедри спортивної медицини, фізичного виховання та реабілітації Вінницького національного медичного університету ім. М. І. Пирогова, м. Вінниця, <http://orcid.org/0000-0002-7483-2155>

Журнал «Перспективи та інновації науки»
(Серія «Педагогіка», Серія «Психологія», Серія «Медицина»)
№ 11(57) 2025

Дусь Сергій Валерійович старший викладач кафедри спортивної медицини, фізичного виховання та реабілітації Вінницького національного медичного університету ім. М. І. Пирогова, м. Вінниця, <http://orcid.org/0000-0002-9865-8301>

Бандурка Наталя Миколаївна доцент кафедри нормальної фізіології Вінницького національного медичного університету ім. М. І. Пирогова; м. Вінниця, <http://orcid.org/0000-0002-4317-9958>

СУЧАСНІ АСПЕКТИ ПРОВЕДЕННЯ РЕАБІЛІТАЦІЇ ПІСЛЯ АМПУТАЦІЇ ВЕРХНІХ КІНЦІВОК

Анотація. Відновлення після ампутації верхньої кінцівки є однією з найскладніших проблем сучасної медицини, оскільки призводить до довічної інвалідизації, зниження якості життя та втрати соціальної й професійної залученості. Зростання частоти травм, виробничих і побутових нещасних випадків, а також воєнних дій і вибухових уражень постійно підвищує частку ампутацій верхніх кінцівок, що додатково посилює навантаження на системи охорони здоров'я та реабілітації. Водночас спостерігається значна варіабельність доступу до протезно-реабілітаційних послуг, а високі показники відмови від протезів у поєднанні зі значною психологічною захворюваністю підкреслюють важливість систематичного аналізу наявних даних щодо сучасних підходів до реабілітації. Метою цього огляду було проаналізувати сучасний стан методів реабілітації та можливостей відновлення у осіб після ампутації верхньої кінцівки. Було проведено нарративний огляд сучасної наукової літератури, проіндексованої в базах даних PubMed та Google Scholar, із використанням ключових слів, пов'язаних з ампутацією верхньої кінцівки, протезною реабілітацією, психічним здоров'ям та соціальною реінтеграцією. Літературні дані послідовно свідчать, що оптимальна реабілітація має бути поетапною, довготривалою та мультидисциплінарною, включати медичний і сестринський догляд, підбір і навчання користуванню протезом, а також структуровану психіатричну та психологічну підтримку з метою покращення виконання повсякденних активностей, контролю болю та загальної якості життя. Потреби пацієнтів очевидно виходять далеко за межі відновлення довільного рухового контролю й охоплюють ведення фантомного та резидуального болю, навчання навичкам одnorукого самообслуговування, адаптацію домашнього й робочого середовища, надання соціальної та фінансової підтримки й активну участь сім'ї, що суттєво впливає на успішність реінтеграції та тривале користування протезом. Нейрореабілітаційні методики, які продемонстрували потенціал у зменшенні фантомного болю та покращенні контролю протеза, включають дзеркальну терапію, віртуальну реальність, моторну уяву, роботизовані системи та інтерфейси «мозок–комп'ютер»; однак доказова база для них наразі обмежена невеликими вибірками та недостатньою кількістю якісних рандомізованих

контрольованих досліджень. Клінічні настанови, зокрема розроблені у системах охорони здоров'я ветеранів та оборонних відомств, передбачають допротезний етап, призначення й підбір протеза, інтенсивне функціональне тренування та довготривале спостереження, проте їх застосування у ресурсно обмежених умовах є утрудненим, а специфічні рекомендації щодо реабілітації при ампутаціях верхніх кінцівок залишаються неповними. Оцінка результатів реабілітації додатково ускладнюється через використання неоднорідних та лише частково валідизованих методик; паралельно дані сенсорного моніторингу продемонстрували феномен «набутої не-користі» протезованою кінцівкою, значну індивідуальну варіабельність у порівняльних перевагах тягових (body-powered) та міоелектричних протезів, а також високі показники відмови, пов'язані з дискомфортом, недостатньою функціональністю, технічними проблемами та невідповідністю реальних можливостей пристрою очікуванням пацієнта. Наявні дані також свідчать, що успішна соціальна та професійна реінтеграція потребує ранньої психологічної оцінки, індивідуалізації реабілітації залежно від рівня ампутації та функціональних цілей, доступу до професійної (воковаційної) реабілітації та підтримки з боку роботодавця, тоді як діти та молодь є особливо вразливою групою щодо розвитку тяжких віддалених психосоціальних наслідків за відсутності спеціалізованих освітніх і реабілітаційних програм. Таким чином, реабілітація після втрати верхньої кінцівки має розглядатися як довготривалий, контекст-орієнтований мультидисциплінарний процес, а подальші високоякісні дослідження разом із впровадженням і локальною адаптацією міжнародних клінічних настанов є необхідними для оптимізації функціональних, психологічних і соціальних результатів у цієї категорії пацієнтів.

Ключові слова: ампутація верхніх кінцівок, післяопераційна реабілітація, протезування верхньої кінцівки, фізична терапія, ерготерапія, якість життя пацієнтів.

Statement of the problem. Living with an upper limb amputation is among the most challenging problems in contemporary rehabilitation medicine because it leads to a permanent loss of functions related to daily living, work and social participation. The proportion of upper limb amputations relative to other major amputations is increasing, and this tendency is largely attributed to road traffic, industrial and domestic accidents, as well as warfare and blast injuries. Analysis of the US National Trauma Data Bank has shown that injuries involving the proximal upper limb are frequently associated with high-energy mechanisms, polytrauma and the need for prolonged surgical and rehabilitation care [1].

Recent reviews in upper limb surgery indicate that amputations at this level carry significant clinical and social implications due to reduced ability to perform fine motor tasks, loss of functional independence and a profound impact on vocational capacity. It is clear that treatment outcomes cannot be reduced to successful surgery alone: multidisciplinary rehabilitation, including prosthetic prescription, physical and

occupational therapy, psychosocial support and patient training in the use of the device, is an essential component of care [2].

Upper limb function in individuals with unilateral upper extremity amputation is closely correlated with both prosthetic use and prosthesis type. Assessment results show that those who regularly use modern prosthetic systems, including myoelectric devices, demonstrate better performance in activities of daily living compared with non-users, as well as higher quality-of-life scores and greater overall satisfaction with their abilities. However, a large proportion of patients reject their prosthesis or use it only sporadically because of discomfort, weight, limited function and difficulties with adaptation, which once again highlights the need for well-structured rehabilitation programmes [3].

Clinical evidence from several countries indicates that the negative impact of upper limb amputation on quality of life is greatest where prosthetic and rehabilitation services are scarce. A study conducted at Cotonou National Teaching Hospital (Benin) showed a marked decline in independence, difficulties in returning to work and substantial economic consequences among individuals with upper limb amputation, against a background of poor prosthetic provision and a lack of specialised rehabilitation programmes [4].

In middle-income countries, additional structural barriers influence access to prosthetic care, including device cost and uneven distribution of rehabilitation resources. A multicentre study from Pakistan among upper limb prosthesis users demonstrated that quality of life is determined not only by the mere availability of a prosthesis, but also by its functional performance, ergonomics, access to maintenance services and the realism of patient expectations. Adequate rehabilitation support and structured training in prosthesis use have been shown to be important predictors of satisfaction and long-term device utilisation [5].

In countries of the Middle East and North Africa, such as Egypt, amputations of the limbs (upper and lower) are also associated with a significant decrease in quality of life, with distinct sex-related differences. Among Egyptian patients, women after amputation more often present with pronounced emotional and social difficulties, limitations in household activities and self-care, as well as marked deterioration in psychological well-being. This underscores the importance of taking gender into account when planning individual rehabilitation programmes and psychosocial support [6].

Mental health in patients with traumatic upper limb amputations constitutes a distinct and important field of study. Clinical data show that depression and post-traumatic stress disorder (PTSD) are common in adults following surgical upper limb amputation, particularly when initial injuries are severe, treatment is prolonged or when persistent sequelae such as residual pain or phantom sensations are present. The coexistence of depressive symptoms and PTSD significantly hinders successful rehabilitation, reduces motivation to use the prosthesis and to engage in more complex therapeutic interventions; thus, psychiatric and psychological management is a mandatory component of clinical standards for this patient group [7].

The level of upper limb amputation (fingers, hand, forearm, arm, shoulder disarticulation or higher) has a direct impact not only on the degree of functional limitation but also on psychological well-being and behavioural responses. Research has shown that the more proximal the amputation, the greater the limitations in self-care and professional activities, which are associated with higher levels of emotional exhaustion, lower self-esteem and the development of maladaptive coping strategies, including increased use of psychoactive substances. This highlights the importance of early psychological assessment and the individualisation of rehabilitation interventions based on amputation level and the patient's functional goals [8].

Management of patients with amputations from a psychiatric perspective requires full appreciation of the biopsychosocial nature of their condition: physical limb loss, chronic pain, disfigurement and its impact on body image and self-identity, as well as socio-economic deprivation. The review by Jo et al. shows that depression, anxiety disorders, PTSD and specific forms of grief and adaptation to an altered body image are frequent diagnoses in these patients. Successful rehabilitation requires multidisciplinary involvement, including psychiatrists, psychologists, physical and occupational therapists, social workers and active family participation, which together reduce psycho-emotional distress and improve treatment adherence [9].

Children and adolescents with limb loss are a particularly high-risk group, as amputation occurs during critical stages of personality development, social identity formation and vocational choice. A systematic review has shown that quality of life in young people with limb absence is determined not only by functional restrictions but also by the degree of social support, availability of specialised rehabilitation and educational programmes, and opportunities for integration into the educational system and labour market. Modern prosthetic technologies can positively influence functional outcomes; however, without adequate psychosocial follow-up and targeted rehabilitation strategies, the risk of long-term psychological sequelae and social withdrawal remains high [10].

Therefore, current knowledge provides compelling evidence that upper limb amputation is not only a surgical and orthopaedic issue, but also a major challenge for rehabilitation medicine and mental health systems. Given the high degree of functional limitation, reduced quality of life and considerable psycho-emotional burden in this patient population, a multimodal, structured, interdisciplinary rehabilitation concept is required. In this context, summarising contemporary issues in rehabilitation following upper limb amputation should focus on integrating medical, prosthetic-orthotic, psychosocial and reintegration components into a comprehensive model of care.

The aim of the study - to assess the current state of rehabilitation opportunities for people after upper limb amputation.

Research objects and methods. An analysis of modern scientific publications selected according to keywords relevant to the research topic was conducted. The search databases Google Academy and PubMed were used to search for sources.

Presentation of the main material.

Research results and their discussion. An analysis of the current literature supports the view that rehabilitation in upper limb amputees should be understood as a comprehensive, staged, multidisciplinary and long-term treatment strategy rather than a simple surgical “add-on.” The systematic review by Soyer et al. demonstrated that early initiation of rehabilitation measures – including physical and occupational therapy, prosthetic training and psychosocial support – leads to improved recovery of activities of daily living, pain reduction and higher rates of return home and to work after amputation [11]. The authors stress that the lack of integrated programmes and poor involvement of the patient and family are associated with greater disability, higher rates of prosthesis abandonment and limited functional recovery.

The review by Shahsavari et al. shows that the needs of people with upper limb amputation extend far beyond achieving movement at the shoulder or elbow [12]. Key “clusters of needs” include pain control (including phantom pain), training in one-handed self-care, adaptation of the home environment, support in addressing social, vocational and financial issues, psycho-emotional follow-up and structured work with the family. The authors emphasise that effective community reintegration is rooted in a combination of clinical rehabilitation and social and medico-psychological support, rather than in prosthetic provision alone.

A parallel line of development exists in the field of neurorehabilitation, which is designed to capitalise on brain neuroplasticity following amputation. In their scoping review, Rydland et al. report on the use of mirror therapy, virtual reality, motor imagery, robotic systems and brain–computer interfaces in adults with traumatic upper limb amputation [13]. Although published outcomes are promising in terms of reducing phantom limb pain, modifying body schema and facilitating prosthesis control, the lack of adequately powered, randomised controlled trials calls for more rigorous and comprehensive studies.

Interagency clinical guidelines provide an important standard for organising rehabilitation. Crunkhorn et al. highlight the main features of the Clinical Practice Guideline from the US Department of Veterans Affairs and the Department of Defense for patients with acquired amputation [14]. A staged concept is emphasised: pre-prosthetic management (analgesia, stump shaping, early mobilisation), prescription and fitting of the prosthesis, intensive training in self-care and ongoing follow-up with periodic re-assessment of needs. At the same time, the authors point to the practical challenges of applying these algorithms in less well-resourced health systems that lack fully functioning multidisciplinary teams.

The selection and standardisation of outcome measures for rehabilitation effectiveness remain a major issue. In their review, Resnik et al. showed that a wide variety of instruments are used in individuals with upper limb trauma and amputation, ranging from strength and range-of-motion measures to activity and participation questionnaires (e.g. DASH, COPM and prosthesis-use-specific tools) [15]. However, many of these scales are not specifically validated for this population, and domains

such as participation, quality of life and satisfaction with the prosthesis are often under-represented. This imbalance makes it difficult to compare outcomes between studies and to build a coherent, evidence-based clinical approach.

In addition, the real-world use of the prosthesis in everyday life deserves special consideration. Using sensor-based monitoring, Chadwell et al. demonstrated that most upper limb activity in myoelectric prosthesis users is still performed by the intact limb, with the prosthesis being used only to a limited extent and often not in the context of goal-directed actions [16]. This phenomenon of “learned non-use” shows that even sophisticated technology may have relatively low functional impact unless it is accompanied by purposely designed programmes of functional training, motivational support and fear reduction.

Studies comparing different prosthetic options also indicate that there is no single “best” prosthesis. Engdahl et al. summarise current views of users and clinicians regarding the balance between body-powered (cable-driven) and myoelectric devices: the former are often perceived as more robust, simple and providing more “intuitive” feedback through the harness, whereas myoelectric prostheses offer greater dexterity and cosmetic appearance, provided that an adequate level of training and technical support is available [17]. In their recommendations on implementing prosthetic technology, Gates et al. emphasise the need for individualised device selection based on amputation level, occupational and daily-living demands, cognitive abilities, motivation and social context, as well as the importance of long-term follow-up and adjustment of prosthetic settings [18].

For individuals with high-level amputation (at the shoulder or above), surgical approaches to optimise prosthetic control become particularly relevant. Sturma et al. report on rehabilitation after targeted muscle reinnervation (TMR), which generates new electromyographic signals that can be used to control multi-articulating prostheses [19]. They indicate that successful rehabilitation following TMR requires highly specialised protocols that combine progressive prosthesis-control training, management of phantom pain and support of body image; at the same time, this method is resource-intensive and currently available mainly in large specialised centres.

Effective rehabilitation should also encompass successful reintegration into society and the workforce. In their study of individuals with upper limb amputation, Lee et al. found that post-amputation employment status is influenced not only by amputation level and prosthesis use, but also by age, education, type of previous occupation, employer support and the availability of vocational rehabilitation [20]. Designing rehabilitation programmes without a structured vocational component and without real opportunities for workplace integration tends to maintain high rates of unemployment and social isolation in this patient group.

The quality of movements performed with a prosthesis is often reduced compared with the intact limb, even when the task is formally completed. Engdahl and Gates demonstrated differences in smoothness, symmetry and coordination of movements during activities of daily living performed with body-powered and

myoelectric devices, which is relevant for preventing overuse problems in the intact arm and the musculoskeletal system as a whole [21]. Gonzalez et al. further point out that “incidental” sensory feedback from body-powered harnesses and from contact between the prosthesis and objects may facilitate motor control, whereas myoelectric systems require specific training strategies and, where possible, integration of additional feedback modalities [22].

In a systematic review of clinical practice guidelines, Heyns et al. showed that, although there is a growing body of recommendations for people with limb loss, a large proportion of guidance is directed towards lower limb amputation, and key aspects of upper limb rehabilitation remain insufficiently covered [23]. The authors highlight the need for detailed, evidence-based protocols that address prosthesis selection, training intensity and duration, outcome measures for different amputation levels, and systematic inclusion of mental health and social reintegration in rehabilitation packages.

Monographic chapters by Atkins and Sturma stress the principles of physiotherapy and occupational therapy in upper limb amputation, particularly early prevention of contractures, stump care with a view to creating a “prosthesis-ready” residual limb, training of prosthetic grasp in functional tasks and gradual progression from controlled exercises to spontaneous performance in real-life contexts [24]. The role of the occupational therapist is emphasised in reducing dependence on others in patients who temporarily or permanently do not use a prosthesis, by teaching one-handed self-care techniques, ergonomic workplace organisation and the effective use of assistive devices.

Finally, prosthesis abandonment remains a major problem for rehabilitation teams. The scoping review by Smail et al. demonstrated that key reasons for discontinuation include discomfort, pain, weight, poor functional performance, technical failures and a mismatch between patient expectations and the actual capabilities of the device [25]. This implies, on the one hand, careful attention to comfort and ergonomics at the stages of prosthesis design, prescription and fitting, and, on the other hand, thorough pre-prosthetic education, realistic goal-setting and long-term follow-up, including the option of device upgrades and modification of the rehabilitation programme.

In conclusion, modern rehabilitation concepts following upper limb amputation are based on a combination of surgical and neurorehabilitation strategies with prosthetic-orthotic, psychosocial and reintegration components. Significant gaps remain in the standardisation of assessment, the strength of evidence for specific methods and the availability of comprehensive programmes, particularly in low-resource settings. These gaps justify further research and the adaptation of international guidelines to local realities within national health care systems.

Conclusions. Rehabilitation after upper limb amputation, based on the above-summarised information, is a staged, long-term and multidisciplinary treatment process. The success of restoring function, quality of life and gainful employment in these patients depends to a considerable extent on early comprehensive rehabilitation,

appropriate prosthesis selection accompanied by targeted user training, and structured psychiatric and psychotherapeutic support. Nonetheless, persistently high rates of prosthesis abandonment, inadequate standardisation of outcome measurement and limited access to comprehensive programmes, particularly in resource-limited settings, reinforce the need for further research and for adaptation of international clinical guidelines to local health systems.

References

1. Inkellis, E., Low, E. E., Langhammer, C., & Morshed, S. (2018). Incidence and characterization of major upper-extremity amputations in the National Trauma Data Bank. *JBJS Open Access*, 3(2), e0038.
2. Pierrie, S. N., Gaston, R. G., & Loeffler, B. J. (2018). Current concepts in upper-extremity amputation. *The Journal of hand surgery*, 43(7), 657-667.
3. Resnik, L., Borgia, M., & Clark, M. (2020). Function and quality of life of unilateral major upper limb amputees: effect of prosthesis use and type. *Archives of physical medicine and rehabilitation*, 101(8), 1396-1406.
4. Tidjani, I. F., Lawson, E., Ouangre, A., Chigblo, P., Alagnide, E., Boko, M., ... & Akue, A. H. M. (2019). Outcomes and Quality of Life in Patients with Upper Limbs Amputations in Cotonou National Teaching Hospital-Benin. *Eur Sci J ESJ*, 15, 1857-7881.
5. Sethi, F., Mumtaz, N., & Saqulain, G. (2021). Determinants of quality of life among upper limb prosthesis users: Pakistan, a multicenter study. *Pakistan Armed Forces Medical Journal*, 71(6), 2037-2040.
6. Mohammed, S. A., & Shebl, A. M. (2014). Quality of life among Egyptian patients with upper and lower limb amputation: sex differences. *Advances in medicine*, 2014(1), 674323.
7. Cohen-Tanugi, S., Reid, R., Loeffler, B. J., & Gaston, R. G. (2024). The prevalence of depression and PTSD in adults with surgically managed traumatic upper-extremity amputations. *HAND*, 19(1), 169-174.
8. Kearns, N. T., Jackson, W. T., Elliott, T. R., Ryan, T., & Armstrong, T. W. (2018). Differences in level of upper limb loss on functional impairment, psychological well-being, and substance use. *Rehabilitation Psychology*, 63(1), 141.
9. Jo, S. H., Kang, S. H., Seo, W. S., Koo, B. H., Kim, H. G., & Yun, S. H. (2021). Psychiatric understanding and treatment of patients with amputations. *Yeungnam University Journal of Medicine*, 38(3), 194-201.
10. Maciver, M., Dixon, D., & Powell, D. (2024). Quality of life in young people with limb loss: a systematic review. *Disability and Rehabilitation*, 46(19), 4323-4334.
11. Soyer, K., Unver, B., Tamer, S., & Ulger, O. (2016). The importance of rehabilitation concerning upper extremity amputees: A Systematic Review. *Pakistan journal of medical sciences*, 32(5), 1312.
12. Shahsavari, H., Matourypour, P., Ghiyasvandian, S., Ghorbani, A., Bakhshi, F., Mahmoudi, M., & Golestannejad, M. (2020). Upper limb amputation; Care needs for reintegration to life: An integrative review. *International journal of orthopaedic and trauma nursing*, 38, 100773.
13. Rydland, J., Spiegel, S., Wolfe, O., Alterman, B., Johnson, J. T., & Wheaton, L. A. (2022). Neurorehabilitation in adults with traumatic upper extremity amputation: a scoping review. *Neurorehabilitation and Neural Repair*, 36(3), 208-216.
14. Crunkhorn, A., Andrews, E., Fantini, C., Highsmith, M. J., Loftsgaarden, M., Randolph, B., ... & Webster, J. (2023). Management of upper limb amputation rehabilitation: synopsis of the 2022 US Department of Veterans Affairs and US Department of Defense Clinical Practice Guideline for Acquired Amputation. *American Journal of Physical Medicine & Rehabilitation*, 102(3), 245-253.

15. Resnik, L., Borgia, M., Silver, B., & Cancio, J. (2017). Systematic review of measures of impairment and activity limitation for persons with upper limb trauma and amputation. *Archives of physical medicine and rehabilitation*, 98(9), 1863-1892.
16. Chadwell, A., Kenney, L., Granat, M. H., Thies, S., Head, J., Galpin, A., ... & Kulkarni, J. (2018). Upper limb activity in myoelectric prosthesis users is biased towards the intact limb and appears unrelated to goal-directed task performance. *Scientific reports*, 8(1), 11084.
17. Engdahl, S. M., Gonzalez, M. A., Lee, C., & Gates, D. H. (2024). Perspectives on the comparative benefits of body-powered and myoelectric upper limb prostheses. *Journal of NeuroEngineering and Rehabilitation*, 21(1), 138.
18. Gates, D. H., Engdahl, S. M., & Davis, A. (2021). Recommendations for the successful implementation of upper limb prosthetic technology. *Hand Clinics*, 37(3), 457-466.
19. Sturma, A., Stamm, T., Hruby, L. A., Bischof, B., Salminger, S., Gstoettner, C., ... & Aszmann, O. C. (2022). Rehabilitation of high upper limb amputees after targeted muscle reinnervation. *Journal of Hand Therapy*, 35(1), 58-66.
20. Lee, C., Engdahl, S., Riegger, A., Davis, A., Kelly, B. M., & Gates, D. H. (2022). Employment status in individuals with upper-limb amputation: a survey of current trends. *JPO: Journal of Prosthetics and Orthotics*, 34(2), 79-88.
21. Engdahl, S. M., & Gates, D. H. (2021). Differences in quality of movements made with body-powered and myoelectric prostheses during activities of daily living. *Clinical Biomechanics*, 84, 105311.
22. Gonzalez, M. A., Lee, C., Kang, J., Gillespie, R. B., & Gates, D. H. (2021). Getting a grip on the impact of incidental feedback from body-powered and myoelectric prostheses. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 29, 1905-1912.
23. Heyns, A., Jacobs, S., Negrini, S., Patrini, M., Rauch, A., & Kiekens, C. (2021). Systematic review of clinical practice guidelines for individuals with amputation: identification of best evidence for rehabilitation to develop the WHO's package of interventions for rehabilitation. *Archives of physical medicine and rehabilitation*, 102(6), 1191-1197.
24. Atkins, D. J., & Sturma, A. (2021). Principles of occupational and physical therapy in upper limb amputations. In *Bionic limb reconstruction* (pp. 197-214). Cham: Springer International Publishing.
25. Smal, L. C., Neal, C., Wilkins, C., & Packham, T. L. (2021). Comfort and function remain key factors in upper limb prosthetic abandonment: findings of a scoping review. *Disability and rehabilitation: Assistive technology*, 16(8), 821-830.

Література

1. Inkellis, E., Low, E. E., Langhammer, C., & Morshed, S. (2018). Incidence and characterization of major upper-extremity amputations in the National Trauma Data Bank. *JBJS Open Access*, 3(2), e0038.
2. Pierrie, S. N., Gaston, R. G., & Loeffler, B. J. (2018). Current concepts in upper-extremity amputation. *The Journal of hand surgery*, 43(7), 657-667.
3. Resnik, L., Borgia, M., & Clark, M. (2020). Function and quality of life of unilateral major upper limb amputees: effect of prosthesis use and type. *Archives of physical medicine and rehabilitation*, 101(8), 1396-1406.
4. Tidjani, I. F., Lawson, E., Ouangre, A., Chigblo, P., Alagnide, E., Boko, M., ... & Akue, A. H. M. (2019). Outcomes and Quality of Life in Patients with Upper Limbs Amputations in Cotonou National Teaching Hospital-Benin. *Eur Sci J ESJ*, 15, 1857-7881.
5. Sethi, F., Mumtaz, N., & Saqulain, G. (2021). Determinants of quality of life among upper limb prosthesis users: Pakistan, a multicenter study. *Pakistan Armed Forces Medical Journal*, 71(6), 2037-2040.

6. Mohammed, S. A., & Shebl, A. M. (2014). Quality of life among Egyptian patients with upper and lower limb amputation: sex differences. *Advances in medicine*, 2014(1), 674323.
7. Cohen-Tanugi, S., Reid, R., Loeffler, B. J., & Gaston, R. G. (2024). The prevalence of depression and PTSD in adults with surgically managed traumatic upper-extremity amputations. *HAND*, 19(1), 169-174.
8. Kearns, N. T., Jackson, W. T., Elliott, T. R., Ryan, T., & Armstrong, T. W. (2018). Differences in level of upper limb loss on functional impairment, psychological well-being, and substance use. *Rehabilitation Psychology*, 63(1), 141.
9. Jo, S. H., Kang, S. H., Seo, W. S., Koo, B. H., Kim, H. G., & Yun, S. H. (2021). Psychiatric understanding and treatment of patients with amputations. *Yeungnam University Journal of Medicine*, 38(3), 194-201.
10. Maciver, M., Dixon, D., & Powell, D. (2024). Quality of life in young people with limb loss: a systematic review. *Disability and Rehabilitation*, 46(19), 4323-4334.
11. Soyer, K., Unver, B., Tamer, S., & Ulger, O. (2016). The importance of rehabilitation concerning upper extremity amputees: A Systematic Review. *Pakistan journal of medical sciences*, 32(5), 1312.
12. Shahsavari, H., Matourypour, P., Ghiyasvandian, S., Ghorbani, A., Bakhshi, F., Mahmoudi, M., & Golestannejad, M. (2020). Upper limb amputation; Care needs for reintegration to life: An integrative review. *International journal of orthopaedic and trauma nursing*, 38, 100773.
13. Rydland, J., Spiegel, S., Wolfe, O., Alterman, B., Johnson, J. T., & Wheaton, L. A. (2022). Neurorehabilitation in adults with traumatic upper extremity amputation: a scoping review. *Neurorehabilitation and Neural Repair*, 36(3), 208-216.
14. Crunkhorn, A., Andrews, E., Fantini, C., Highsmith, M. J., Loftsgaarden, M., Randolph, B., ... & Webster, J. (2023). Management of upper limb amputation rehabilitation: synopsis of the 2022 US Department of Veterans Affairs and US Department of Defense Clinical Practice Guideline for Acquired Amputation. *American Journal of Physical Medicine & Rehabilitation*, 102(3), 245-253.
15. Resnik, L., Borgia, M., Silver, B., & Cancio, J. (2017). Systematic review of measures of impairment and activity limitation for persons with upper limb trauma and amputation. *Archives of physical medicine and rehabilitation*, 98(9), 1863-1892.
16. Chadwell, A., Kenney, L., Granat, M. H., Thies, S., Head, J., Galpin, A., ... & Kulkarni, J. (2018). Upper limb activity in myoelectric prosthesis users is biased towards the intact limb and appears unrelated to goal-directed task performance. *Scientific reports*, 8(1), 11084.
17. Engdahl, S. M., Gonzalez, M. A., Lee, C., & Gates, D. H. (2024). Perspectives on the comparative benefits of body-powered and myoelectric upper limb prostheses. *Journal of Neuro Engineering and Rehabilitation*, 21(1), 138.
18. Gates, D. H., Engdahl, S. M., & Davis, A. (2021). Recommendations for the successful implementation of upper limb prosthetic technology. *Hand Clinics*, 37(3), 457-466.
19. Sturma, A., Stamm, T., Hruby, L. A., Bischof, B., Salminger, S., Gstoettner, C., ... & Aszmann, O. C. (2022). Rehabilitation of high upper limb amputees after targeted muscle reinnervation. *Journal of Hand Therapy*, 35(1), 58-66.
20. Lee, C., Engdahl, S., Riegger, A., Davis, A., Kelly, B. M., & Gates, D. H. (2022). Employment status in individuals with upper-limb amputation: a survey of current trends. *JPO: Journal of Prosthetics and Orthotics*, 34(2), 79-88.
21. Engdahl, S. M., & Gates, D. H. (2021). Differences in quality of movements made with body-powered and myoelectric prostheses during activities of daily living. *Clinical Biomechanics*, 84, 105311.
22. Gonzalez, M. A., Lee, C., Kang, J., Gillespie, R. B., & Gates, D. H. (2021). Getting a grip on the impact of incidental feedback from body-powered and myoelectric prostheses. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 29, 1905-1912.

Журнал «Перспективи та інновації науки»
(Серія «Педагогіка», Серія «Психологія», Серія «Медицина»)
№ 11(57) 2025

23. Heyns, A., Jacobs, S., Negrini, S., Patrini, M., Rauch, A., & Kiekens, C. (2021). Systematic review of clinical practice guidelines for individuals with amputation: identification of best evidence for rehabilitation to develop the WHO's package of interventions for rehabilitation. *Archives of physical medicine and rehabilitation*, 102(6), 1191-1197.

24. Atkins, D. J., & Sturma, A. (2021). Principles of occupational and physical therapy in upper limb amputations. In *Bionic limb reconstruction* (pp. 197-214). Cham: Springer International Publishing.

25. Smail, L. C., Neal, C., Wilkins, C., & Packham, T. L. (2021). Comfort and function remain key factors in upper limb prosthetic abandonment: findings of a scoping review. *Disability and rehabilitation: Assistive technology*, 16(8), 821-830.