New Day in Medicine
Новый День в Медицине
NDM

TIBBIYOTDA YANGI KUN

Ilmiy referativ, marifiy-ma'naviy jurnal

AVICENNA-MED.UZ

ISSN 2181-712X.
EiSSN 2181-2187

12 (86) 2025

ТИББИЁТДА ЯНГИ КУН
НОВЫЙ ДЕНЬ В МЕДИЦИНЕ
NEW DAY IN MEDICINE

Илмий-рефератив, маънавий-маърифий журнал
Научно-реферативный,
духовно-просветительский журнал

УЧРЕДИТЕЛИ:

БУХАРСКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ ИНСТИТУТ
ООО «ТИББИЁТДА ЯНГИ КУН»

Национальный медицинский исследовательский центр хирургии имени А.В. Вишневского является генеральным научно-практическим консультантом редакции

Журнал был включен в список журнальных изданий, рецензируемых Высшей Аттестационной Комиссией Республики Узбекистан (Протокол № 201/03 от 30.12.2013 г.)

12 (86)

2025
декабрь

www.bsmi.uz
https://newdaymedicine.com E:
ndmuz@mail.ru
Тел: +99890 8061882

Received: 20.11.2025, Accepted: 06.12.2025, Published: 10.12.2025

UDK 617.586 + 616.379-008.64

СРАВНИТЕЛЬНАЯ ОЦЕНКА ЭФФЕКТИВНОСТИ ИСПОЛЬЗОВАНИЯ ЛЕЧЕБНО-ДИАГНОСТИЧЕСКОГО АЛГОРИТМА У БОЛЬНЫХ С ГИПЕРКЕРАТОЗАМИ И РАННИМИ ДЕФОРМАЦИЯМИ СТОПЫ

Мардонов Жонибек Нумонович https://orcid.org/0009-0002-4468-0426 *e-mail:*jonmoh86@gmail.com
Хамдамов Бахтиёр Зарифович https://orcid.org/0000-0003-3569-6688
e-mail: xamdamov.baxtiyor@bsmi.uz

Бухарский государственный медицинский институт имени Абу Али ибн Сины, Узбекистан, г. Бухара, ул. А. Навои. 1 Тел: +998 (65) 223-00-50 e-mail: info@bsmi.uz

✓ ***Резюме***

Клиническое применение операций в соответствии с уровнем структурной нестабильности обеспечило воспроизводимость результатов и устранение ключевых факторов рецидивирования, что подтвердило концептуальную состоятельность предложенного ЛДА

Ключевые слова: гиперкератоз, деформация стопы, лечебно-диагностический алгоритм

GIPERKERATOZ VA OYOQ DEFORMATIYALARI BO'LGAN BEMORLARDA DAVOLASH VA DIAGNOSTIK ALGORITMIDAN QO'LLANISH SAMARADORLIGINING QIYOSIY BAHOLASH

Mardonov Jonibek Numonovich https://orcid.org/0009-0002-4468-0426 *e-mail:* jonmoh86@gmail.com
Xamdamov Baxtiyor Zarifovich https://orcid.org/0000-0003-3569-6688
e-mail: xamdamov.baxtiyor@bsmi.uz

Abu Ali ibn Sino nomidagi Buxoro davlat tibbiyot instituti, O‘zbekiston, Buxoro sh. A. Navoiy kochasi 1 Tel: +998 (65) 223-00-50 e-mail: info@bsmi.uz

✓ ***Rezyume***

Strukturaviy beqarorlik darajasiga muvofiq operatsiyalarning klinik qo'llanilishi natijalarning qaytalanishi va takrorlanishning asosiy omillarini bartaraf etishni ta'minladi, bu esa taklif qilingan davolash va diagnostika algoritmining kontseptual asosliligini tasdiqladi.

Kalit so'zlar: giperkeratoz, oyoq panjasi deformatsiyasi, davolash va diagnostika algoritmi

COMPARATIVE EVALUATION OF THE EFFECTIVENESS OF USING A TREATMENT AND DIAGNOSTIC ALGORITHM IN PATIENTS WITH HYPERKERATOSIS AND EARLY FOOT DEFORMITIES

Mardonov Zhonibek Numonovich https://orcid.org/0009-0002-4468-0426 *e-mail:*jonmoh86@gmail.com
Khamdamov Bakhtiyor Zarifovich https://orcid.org/0000-0003-3569-6688
e-mail: xamdamov.baxtiyor@bsmi.uz

Bukhara State Medical Institute named after Abu Ali ibn Sina, Uzbekistan, Bukhara, st. A. Navoi. 1 Tel: +998 (65) 223-00-50 e-mail: info@bsmi.uz

✓ ***Resume***

Clinical application of surgeries according to the level of structural instability ensured reproducibility of results and elimination of key factors of recurrence, which confirmed the conceptual validity of the proposed LDA.

Keywords: hyperkeratosis, foot deformity, treatment and diagnostic algorithm

Relevance

The treatment of hyperkeratosis and overload foot deformities in diabetes mellitus has been the subject of repeated research in both clinical endocrinology and orthopedic surgery in recent years. Despite the diversity of approaches, a significant portion of the studies primarily focus on controlling the consequences of pathological loading rather than its underlying cause (1,3,5).

Historically, soft-tissue treatments have dominated, focusing on hyperkeratosis removal, debridement of superficial lesions, antimicrobial treatment, and the use of various types of orthopedic unloading. These measures have been thoroughly studied and repeatedly compared in clinical reviews; however, their impact on recurrence rates remains limited. Hyperkeratosis removal, the use of unloading insoles, and therapeutic footwear provide only temporary load reduction, as they do not address the structural cause of the overload (2,4,6).

Some authors have attempted to use baropodometric methods to stratify risk and identify areas of overload.

Approaches based on the analysis of clinical observations also failed to identify transitional states such as a latent preulcer cavity, recurrent hyperkeratosis, or initial signs of osteolysis and to consider them as interrelated stages of a single pathogenetic process (8,10).

In recent years, attempts have been made to use prognostic models and algorithms based on the analysis of large data sets; however, most of these approaches focus on predicting the ulcer defect rather than early structural changes. Parameters of local overload, recurrent hyperkeratosis, and bone support of the lesion have not been integrated into unified digital tools. There are no scales capable of quantitatively reflecting the degree of biomechanical instability and the risk of lesion progression, making standardization of treatment strategies impossible (7,9).

Thus, despite a significant number of studies, this problem remains understudied at key levels. Existing studies describe individual elements of the process (hyperkeratosis, early destruction, local overload, or podiatric correction), but do not integrate them into a unified pathogenetic system. There are no quantitative criteria to objectively identify patients for whom soft-tissue management will be insufficient. Threshold values for baropodometry and early bone changes indicating the need for minor bone interventions have not been defined. Algorithms linking clinical data with biomechanical and radiographic characteristics into a unified framework for selecting a treatment strategy are lacking.

The aim of the study: comparative evaluation of the use of treatment and diagnostic algorithm and methods of surgical treatment of hyperkeratosis and early foot deformities in patients with diabetes mellitus.

Materials and methods

To objectively assess the condition of the foot and develop a tool for the formation of a substantiated surgical approach, a retrospective analysis revealed the need to divide patients into subgroups depending on the presence or absence of NPP. This approach allowed us to compare the clinical, baropodometric, and other characteristics of the lesion in two fundamentally different clinical situations. The first subgroup included 38 patients (52.8%) with hyperkeratosis without signs of NPP and probability to the bone; the inclusion criteria were the absence of a soft tissue defect, the absence of severe inflammation, and the absence of subepithelial cavities according to ultrasound data. The second subgroup included 34 patients (47.2%) with NPP, confirmed by a combination of clinical signs (the presence of a defect, maceration, infiltration), a positive probing test, local hyperthermia, and signs of overload involvement of bone structures. This distribution of patients made it possible to form a balanced basis for further analysis and identification of criteria necessary for an objective assessment of the pathological support and the selection of a justified surgical tactic.

A comprehensive analysis of clinical, laboratory, and instrumental diagnostic data revealed that traditional verification of hyperkeratosis and associated foot lesions captured only superficial manifestations of the process, while key pathogenesis elements remained unnoticed. Clinical signs identified complaints, inflammation, and fungal infection, but did not reflect the degree of structural failure of the forefoot. Laboratory parameters demonstrated a progressive inflammatory background and more frequent decompensation of diabetes in patients with NUP, but these changes became noticeable only at an advanced stage of the disease.

Results and discussion

The presented treatment and diagnostic algorithm (TDA) was developed based on a consistent assessment of clinical, biomechanical, and radiographic parameters, enabling a transition from a descriptive approach to a structured approach to surgical intervention selection. To establish the true clinical value of the developed method, a comparison of immediate treatment outcomes was conducted in the study group, where LDA was used as a decision-making tool, and in the control group, treated with traditional methods without a structured assessment of the overload and bone support of the lesion. This verification requires a comparison of key early outcomes, as they reflect the effectiveness of defect debridement, the degree of stabilization of the process, and the likelihood of progression to unfavorable forms of the disease. The comparison of these indicators demonstrates a significant advantage of LDA in achieving the primary treatment goals.

Complete healing by discharge was observed in 67 (89.3%) patients in the study group and 54 (75%) patients in the control group. The epithelialization period was shorter in the study group, lasting 10.8±3.4 days versus 18.1±6.7 days in the control group ($p < 0.001$). A more than 50% reduction in defect area by day 14 was observed in 61 (81.3%) patients in the study group and 46 (63.9%) patients in the control group, indicating more rapid local stabilization of the lesion under the influence of a strategy aimed at eliminating the source of congestion.

The structure of complications also demonstrates significant differences, with repeat necrectomy required in only 2 (2.7%) patients in the study group, while in the control group, such interventions were performed in 12.5% (9 patients) of cases. The incidence of localized infections was lower in the study group, reaching 6.7% (5 patients) compared to 15.3% (11 patients) in the control group. The need for amputation of a toe or distal part of the foot decreased from 9.7% (7 patients) to 1.3% (1 patient). These differences suggest that the use of our LDA not only provides faster disease correction but also reduces the incidence of early complications associated with recurrence or progression of pathological support.

A comparison of long-term treatment results over 12 months revealed significant differences between the groups, reflecting the sustainability of the achieved effect and the ability of LDA to prevent structural progression of the process.

Recurrence of hyperkeratosis in the initial zone was observed in 46 (63.9%) patients in the control group and only 19 (25.3%) patients in the study group. This gap indicates that eliminating pathological support through bone-unloading interventions and subsequent unloading reduces the likelihood of hyperkeratosis recurrence by almost fourfold. A similar trend was observed when analyzing ulcer recurrences. In the control group, ulcer recurrences were detected in 34 patients (47.2%), while in the study group, they occurred in only 7 patients (9.3%). The reduction in the frequency of ulcer defect recurrence with LDA demonstrates that the key pathogenetic mechanisms of overload and bone support were eliminated in most cases.

The formation of new ulcer zones was observed significantly less frequently in the study group, where this rate was 5.3% (4 cases) versus 18% (13 cases) in the control group. This indicates that LDA reduces not only the likelihood of recurrence but also the risk of new lesions, which traditionally develop due to load shifting and the involvement of previously intact areas.

Analysis of deformity progression also confirmed the effect of structural unloading of the foot. In the control group, increasing deformity was recorded in 42 patients (58.3%), while in the study group, this rate reached only 18.7% (14 patients). This dynamic indicates that interventions aimed at reducing bone support to the lesion slow the cascade of deformity changes, which remains untreatable with traditional tactics. The frequency of reoperations also varied significantly, with 28 (38.8%) patients in the control group requiring them compared to 4.85 times less frequently in the study group. This reflects a reduced accumulation of biomechanical errors and the prevention of the disease progressing to a chronic phase requiring staged interventions.

Toe amputations were performed in 12 (16.7%) patients in the control group and 4.2 times less frequently in the study group. Forefoot or lower leg amputations were rare in both groups, but the observed differences maintained the same trend: 8.3% (6 patients) in the control group versus 1.3% (1 case) in the study group. Ultimately, foot weight-bearing ability was maintained in 63 (84%) patients in the study group, exceeding the control group's rate by 22.9%, or almost 1/4. The inclusion of a treatment outcome classification increased the differences between the groups, with a "good outcome,"

defined by the preservation of both anatomical integrity and functional capacity of the lower limb, achieved in 59 (78.7%) patients in the study group, significantly exceeding the control group's rate of 32 patients (44.4%).

A "satisfactory outcome," associated with partial loss of anatomical integrity with preserved weight-bearing function of the limb, was recorded in 11 (14.7%) and 12 (16.7%) patients in both groups, respectively. An "unsatisfactory outcome," including the loss of both anatomical integrity and weight-bearing capacity of the lower limb, was observed in 6 (8.3%) patients in the control group, compared to only 1 (1.3%) patient in the study group. This distribution confirms that the use of the LDA we developed primarily ensures favorable outcomes and reduces the likelihood of severe forms of the disease, which is one of the key criteria for clinical efficacy.

Analysis of the dynamics of baropodometric parameters showed that the elimination of local overload is one of the central mechanisms for improving the results in the study group (Table 1). In the control group, the local peak pressure decreased insignificantly, while in the study group its value decreased more than 2-fold ($p < 0.05$). The proportion of patients with a pronounced peak load of more than 35 N/cm2 in the control group decreased from 79.2% to 72.2%, indicating minimal change in support function, while in the study group this indicator decreased from 82.7% to 14.7% ($p < 0.05$). This comparison demonstrates that the use of LDA allows for the elimination of a key pathogenetic link, that is, a persistent zone of increased support pressure, which, with traditional treatment, persists even after podiatric treatment of soft tissues.

Table 1

Comparative assessment of the dynamics of changes in foot barometric parameters

INDICATOR	PATIENT GROUPS AND TREATMENT DYNAMICS			
	Control (n=72)		Main (n=75)	
	To	After	To	After
Local pressure peak (H/см^2)	52,4±7,2	48,7±5,1	55,1±6,3	28,3±3,2*
Pronounced peak load >35 H/см^2	57 (79,2%)	52 (72,2%)	62 (82,7%)	11 (14,7%)
hifting the center of pressure (мм)	8,4±2,1	7,9±1,2	9,1±2,3	2,2±0,4*
Pathological axis of support	49 (68,1%)	45 (62,5%)	51 (68%)	9 (12%)

***Note:** *p <0,05 – statistically significant changes compared to before treatment within one group*

Changes in the position of the center of support pressure reflected the ability of the LDA to correct the support axis and reduce biomechanical instability. In the control group, the displacement of the center of support pressure decreased from 8.4 ± 2.1 mm to 7.9 ± 1.2 mm, which was not accompanied by a significant change in the load structure. In the study group, after bone unloading interventions, the displacement decreased from 9.1 ± 2.3 mm to 2.2 ± 0.4 mm ($p < 0.05$), indicating restoration of the support axis and redistribution of the load within physiological zones. Such correction creates conditions for the prevention of ulcer recurrence and slows the deformation process, as it removes the mechanical factor that maintains tissue damage.

The rate of abnormal support axis also differed significantly between the groups. In the control group, the proportion of patients with abnormal support axis decreased only from 68.1% to 62.5%, while in the study group, the rate decreased from 68% to 12%. These changes confirm that LDA eliminates not only the manifestations of localized overload but also the structural context of its formation. Correction of bone support and subsequent unloading ensure the restoration of biomechanical stability of the forefoot, which is the basis for achieving a lasting clinical effect.

A comparison of the economic load between the two groups revealed a significant difference, which is fully consistent with the specific treatment strategy (Table 2).

Table 2

Comparative assessment of economic efficiency and resource intensity

INDICATOR	GROUPS OF PATIENTS	
	Control (n=72)	Main (n=75)
Average bed-days, days	6,1±1,4	3,8±0,4*
Number of dressings, units.	14,2±5,3	8,9±3,1*
Repeat visits, units	4,7±0,9	2,3±0,4*
Repeated operations, units	28 (38,8%)	6 (8%)

***Note:** *p <0,05 – statistically significant changes compared to the control group*

In the control group, the average length of hospitalization was 6.1±1.4 bed-days, while in the study group this figure decreased by 1.6 times ($p < 0.05$), reflecting a shorter active treatment period due to more rapid stabilization of the lesion. The number of dressing changes also differed significantly. In the control group, they were performed an average of 14.2±5.3 times, while in the study group they were performed 1.6 times less often ($p < 0.05$). The number of outpatient visits after discharge decreased from 4.7±0.9 times to 2.3±0.4 times ($p < 0.05$), which is associated with a lower complication rate and more stable defect healing. A significant difference was also found in the number of repeat surgeries ($p < 0.05$), reducing the risk of readmission and additional material costs.

The summary indicator of treatment costs, calculated as a conditional value, demonstrated a significant reduction in costs using the LDA we developed. Total costs in the study group were approximately 62% of those in the control group, equivalent to a 38% reduction in costs. This distribution reflects not only a reduction in hospital stay but also a reduction in the need for dressings, the frequency of repeat interventions, and the costs of treatment and diagnostic procedures. Taken together, these differences confirm that our proposed LDA not only improves clinical outcomes but also provides significant economic benefits, making it feasible for implementation in practical healthcare.

Conclusions

1. Integrating the "COLP" scale into the LDA allowed us to differentiate the indications for two of our surgical methods, namely, baropodometrically guided mini-exostectomy and limited correction of the osseous support of the lesion. Elimination of the pathological support area resulted in a more than 2-fold reduction in local peak pressure, a 4.1-fold reduction in the displacement of the support center, and the disappearance of the pathological support axis in 88% of patients.

2. Clinical application of operations according to the level of structural instability ensured reproducibility of results and elimination of key factors of recurrence, which confirmed the conceptual validity of the proposed LDA.

LIST OF REFERENCES:

1. Apsamatov N.K., Khamidzhan Uulu A., Maratov N.M. and others. Diagnosis and treatment of SDS at the present stage // Bulletin of Science and Practice. 2025;11(6):196-208.
2. Bregovsky V.B., Demina A.G., Karpova I.A. et al. Relapses of foot ulcers in patients with diabetes in outpatient practice // Bulletin of surgery named after. I.I. Grekova. 2022;181(2):49-56.
3. Egiazaryan K.A., Miroshnikova E.A., Zhavoronkov E.A. and others. Analysis of the results of surgical treatment of complex forefoot deformities in older patients // Politravma. 2021;3:46-53.
4. Makhmudova L.Sh., Muratova S.N. Podological care for patients with diabetic foot syndrome // Student science and medicine of the 21st century: traditions, innovations and priorities. SMART: XVI All-Russian (90th final) student scientific conference of the Student Scientific Society with international participation: materials, Samara, April 13-14, 2022. - Samara: OOO SamLuxPrint, 2022; 119-120 pp.
5. Okhunov A.O., Kasimov U.K., Atakov S.S. Results of using different types of open osteotomies of the fifth metatarsal bone in Taylor's deformity // Young Specialist. 2023;5(14):3-13.
6. Tsed A.N., Ilyushchenko K.G., Dulaev A.K. et al. Results of using different types of open osteotomies of the fifth metatarsal bone in Taylor's deformity // Bulletin of Surgery named after I.I. Grekov. 2025;184(2):43-51.
7. Albulescu R., Dima S.O., Florea I.R. et al. COVID-19 and diabetes mellitus: unraveling the hypotheses that worsen the prognosis (review) // Exp Ther Med. 2020;20(6):194.
8. Alsabek M.B., Abdul Aziz A.R. Diabetic foot ulcer, the effect of resource-poor environments on healing time and direct cost: a cohort study during Syrian crisis // Int Wound J. 2022;19(3):531-537.
9. D'Souza R.S., Barman R., Joseph A., Abd-Elsayed A. Evidence-based treatment of painful diabetic neuropathy: a systematic review // Curr Pain Headache Rep. 2022;26(8):583-594.
10. Liu Y., Zhang H. Recurrence patterns of diabetic foot ulcers and inadequacy of traditional clinical risk models: a systematic review of Chinese cohorts // Front Endocrinol (Lausanne). 2024;15:1387221.

Entered 20.11.2025