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Differentiated Strategy For Performing Reconstructive Plastic Surgery For Diabetic Foot Syndrome

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Abstract: The aim is to improve the results of treatment of patients with wound defects in diabetic foot syndrome due to a differentiated approach of foot surgery

Key words: Diabetes mellitus, Diabetes Atlas

Relevance. Diabetes mellitus is the most common endocrine disease in the world. According to the IDF Diabetes Atlas for 2021, 587 million patients with diabetes are registered in the world, and according to forecasts, 1 billion people will suffer from diabetes by 2045 [2]. According to statistics for 2021, 3582865 patients were diagnosed with diabetes in our country [1, 2].
Specialists have been regularly studying the problem of diabetes mellitus and its complications for the last 20-30 years. During these years, various theories of the etiopathogenesis of DM were proposed, the main factors of the development of the disease were identified. Towards the end of the XX century, most scientists came to a consensus that in diabetes mellitus, a number of tissues, organs and systems are simultaneously involved in the pathological process. One of the most severe and threatening complications of DM is the lesion of the lower extremities [3, 5, 9].
Performing early reconstructive operations is a mandatory component of surgical treatment of diabetic foot syndrome. To close wound surfaces, such methods as primary and secondary sutures, autodermoplasty, plastic surgery with local tissues by metered tension, wound plastic surgery using flaps cut from local foot tissues are used [4, 7].However, the use of these techniques in patients with type 2 diabetes mellitus with diabetic foot syndrome after "small" operations currently refers more to casuistry than to any regularity: the use of flaps cut from local tissues, for example, in the ischemic form of SDS is impossible: divergence of sutures, necrosis of the displaced flap occurs in almost 100% of cases. Currently, there are no studies concerning the methods, timing, indications for autodermal closure of wounds and, in particular, in patients with type 2 diabetes mellitus after "small" foot operations [6, 8, 13].
Unfortunately, to date, there are no studies that reflect in detail the algorithm of preoperative preparation and postoperative monitoring in this severe category of patients, as well as in patients with unfavorable prognostic factors. High rates of repeated operations and the frequency of postoperative complications are associated with the inadequacy of the choice of surgical intervention technique in the formation of an adequate foot [9, 11]. In this case, an adequate assessment of the peripheral arterial bed with preservation of the integrity of the nutrient artery of a certain area of the foot, which plays an important role in the nutrition of foot tissues, and the choice of the type of surgical method depending on the affected part for the formation of a supporting foot is crucial [10].

The purpose of the study the aim is to improve the results of treatment of patients with wound defects in diabetic foot syndrome due to a differentiated approach of foot surgery.

Material and methods of research
The results of surgical treatment of 115 patients with purulent-necrotic foot lesions who underwent various methods of reconstructive plastic surgery on the foot were analyzed. The patients were hospitalized in the department of purulent surgery of the multidisciplinary clinic of the Tashkent Medical Academy in 2015-2022. Depending on the performed surgical method of treatment, the patients were divided into 2 groups. Group 1 (comparison) consisted of 62 (54.0%) patients who received inpatient treatment in 2015-2018. These patients underwent reconstructive plastic surgery by the traditional method, without taking into account the character and localization of the wound defect on the foot.

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The 2nd group, which was the main one, included 53 (46.0%) patients who were on inpatient treatment in 2019-2022. Reconstructive plastic surgery on the foot was performed by him according to an improved differentiated method, taking into account the affected anatomical part of the foot.

When choosing the type of reconstructive plastic surgery, the anatomical structure of the foot was taken into account (Fig. 1.). In patients of the main group, reconstructive plastic surgery was performed on the foot, based on the localization of the wound defect. We took into account the state of the bone skeleton of the foot and strictly observed the angiosomal principle of arterial nutrition of its tissues.

Fig. 1. Anatomical structure of the foot skeleton.

As you know, the foot is divided into 3 parts: front, middle and back. Each of these parts has its own characteristics. The front part of the foot contains little muscle mass and a lot of tendons that give elasticity to the foot. The middle part, connecting the back to the front, plays an important role in walking due to the structure of the tarsal bones. There is enough muscle mass and tendons in this part to maintain coordination. The back of the foot, which is responsible for the supporting function, takes the brunt of the weight when walking. Therefore, we took into account all the parameters of the foot in parts and chose a suitable reconstructive plastic surgery depending on the function of this part and for the prevention of further long-term complications or changes in the biomechanics of the foot.

Along with the operation, all patients with purulent-necrotic foot wound on the background of diabetes mellitus received systemic antibacterial, double antiplatelet, vasodilating therapy and an intensive complex of therapeutic measures. When choosing the strategy of surgical intervention in patients of the comparison group, the severity of the disease, the nature of the pathological process and the sensitivity of the bacterial flora to antibacterial drugs were taken into account.

The patients were aged from 40 to 72 years, and the majority of them – 74 (64.3%) – from 40 to 60 years (Table 2.1). The average age of patients in the main group was 56.2±3.9 years, the comparison group was 58.6±4.2 years. 75.6% were men.

Table 1.

Distribution of patients depending on the localization of the purulent-necrotic process on the foot

The volume of the lesion	The main group, n=53		Comparison group, n=62	
	abs.	%	abs.	%
Distal part of the foot	11	20,8	15	24,2
The middle part of the foot	35	66,0	39	62,9
The back of the foot	7	13,2	8	12,9
Total	53	100	62	100

In patients who underwent reconstructive plastic surgery on the foot, ischemic and neuroischemic forms of SDS were diagnosed (Table 2). The appearance of GNPS associated with occlusive-stenotic lesions of

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arterial blood flow and signs of damage to peripheral nerve endings, that is, the neuroishemic form of SDS, occurred in 24 (20.8%) of the examined, neuropathic– in 91 (79.2%).

Table 2.

Distribution of patients depending on the form of SDS

DMF Form	The main group, n=53		Comparison group, n=62	
	abs.	%	abs.	%
Neuropathic	39	73,6	52	83,8
Neuroishemic	14	26,4	10	16,2
Total	53	100	62	100

All patients with neuroischemic form of SDS underwent endovascular revascularization (transluminal balloon angioplasty). In the neuropathic form, there was no need for endovascular interventions, and only in patients of the main group with a high risk of postoperative complications, intra-arterial catheter therapy was performed.

Clinical observation.

Patient Z.S., 69 years old, I/b No. 3415/1251. Received on 08.11.2020 with complaints of pain, redness and a neurotrophic wound on the plantar surface of the left foot. From anamnesis: suffers from diabetes mellitus for 17 years, regularly takes hypoglycemic drugs (insulin). According to the patient, he has been ill for 3 months, he does not associate his illness with anything. From anamnesis: repeatedly operated. Upon admission, the patient's condition is of moderate severity. Blood test: Hb – 97 g/l, er. – 2,9x109, l. – 9x109, ESR – 20, blood sugar – 10.2 mmol/l. Urea – 7.5 mmol/l, creatinine – 96 mmol/l.

Locally: the lower extremities are asymmetrical due to swelling of the left shin and foot. On the left foot, there is redness, swelling, soreness and a neurotrophic wound in the plantar surface. The symptom of fluctuation is negative. The blood flow is main in the peripheral arteries, no pathology was detected during duplex scanning (Fig. 2).

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Fig. 2. The appearance of the foot upon admission (a). There is a prolapse of the bones of the tarsus (b).

The regional lymph nodes in the inguinal region on the left are slightly enlarged. The sensitivity on the foot is sharply reduced. There is a neurotrophic ulcer of the plantar surface measuring 3.0x2.5 cm, cloudy-serous discharge. Diagnosis: type 2 diabetes mellitus, severe form in the stage of decompensation. "Diabetic foot syndrome", neuropathic form. Neurotrophic ulcer of the plantar surface of the left foot.
In addition to infusion therapy, the patient was prescribed a course of empirical antibacterial therapy: cefaperazone + sulbactam 3.0 g 2 times a day, clindamycin 600 mg 2 times a day i / m, fluconazole 100 ml I / v, heparin 1.0 ml 3 times a day n / a and insulin therapy.

a *b*

Fig. 3. X-ray picture of the foot. There is destruction of the sphenoid bone (a) and its prolapse (b).

Instrumental studies: with UZDG on the foot, the main blood circulation. Radiologically, signs of destruction are noted on the tarsal bones of the foot. There is a distinct destruction of the sphenoid bone and

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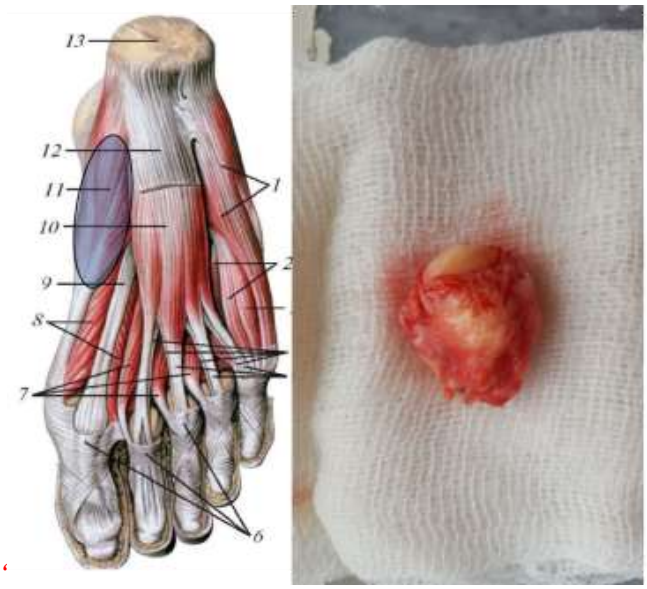
its prolapse. At the same time, the 1st metatarsal bone is intact and is not involved in the process (Fig. 3). On 10.11.2020, the patient underwent resection of the sphenoid bone and myoplasty with the help of the *muscle withdrawing the I finger.*



a *b*

Fig. 4. The removed part of the bone (a) and used for myoplasty of the muscle (b).

At the same time, we changed the foot fulcrum with the correction of prolapse, which gives relief of the surgical site. The residual part of the sphenoid bone is unchanged, secondary flat feet are noted (Fig. 5).

Fig. 5. Postoperative view of the foot (a) and X-ray picture after resection of the sphenoid bone (b).

The patient was discharged in a satisfactory condition on the 5th day after the operation. She was in outpatient treatment and observation for 3 months, started walking a month and a half after the operation with the help of orthopedic shoes. A recurrent neurotrophic ulcer appeared in the dynamics of walking in the area of the postoperative wound (Fig. 6.).

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Fig. 6. Local status of the foot 3 months after surgery.

The results obtained and the discussion.

Based on the results obtained, we analyzed the functional and musculoskeletal safety of the foot of patients of the studied groups after reconstructive plastic surgery. Functional preservation was the condition of the patient's foot, when all the functions of the foot are preserved, despite the removal of one or two fingers. The musculoskeletal safety of the foot meant the preservation of the heel area of the foot (after amputation of the foot according to Sharpe), since some functions of the foot will lose, and individual correction is required in the rehabilitation period of treatment.

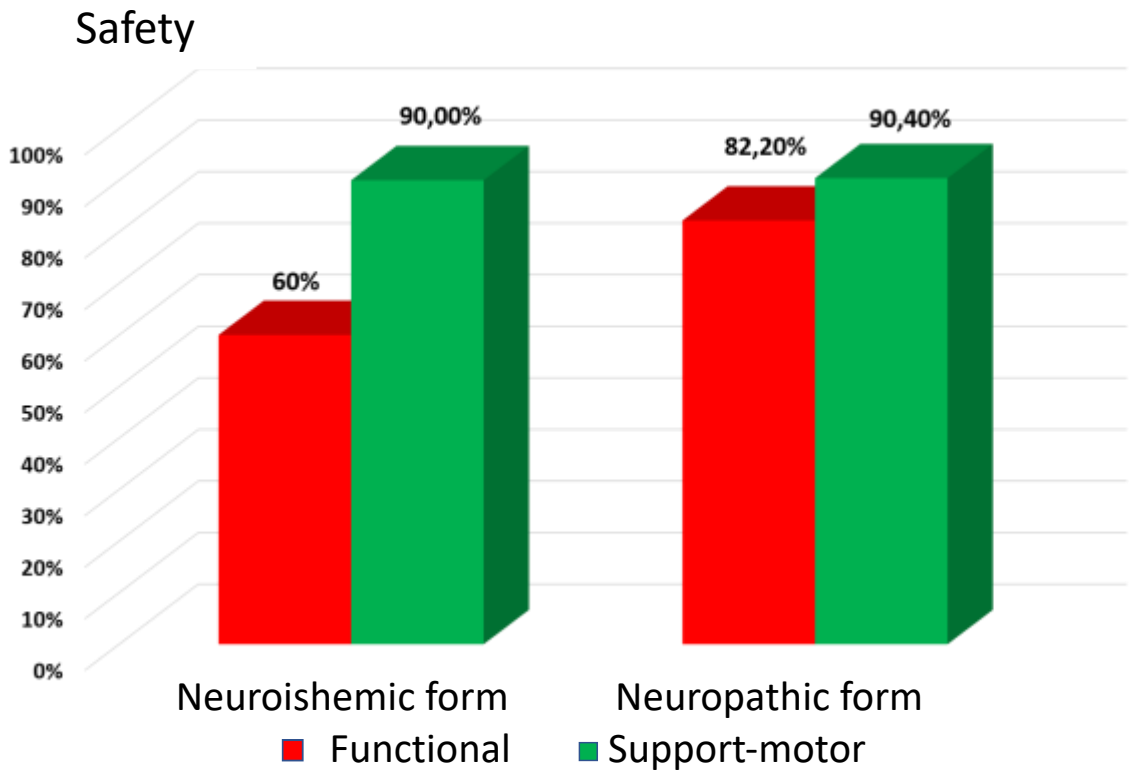

Fig. 7. Preservation of foot function in patients of the comparison group.

The study of the safety of the foot, depending on the form of SDS, showed that the neuropathic form is a more favorable condition for functional safety (with the neuroischemic form – 60%, with the neuropathic form – 82.2%). This is explained by the lesion of the peripheral arteries of the lower extremities in the neuroischemic form of SDS. The frequency of musculoskeletal foot preservation in both forms of SDS was

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almost the same: in the neuroischemic form it occurred in 90.0% of cases, in the neuropathic form - in 90.4%.

Based on the data obtained, it can be concluded that the localization of a wound defect on the foot in patients with purulent-necrotic foot wound on the background of SDS has a direct effect on the postoperative result. At the same time, the most critical is the heel area, which, in turn, requires special attention and a management strategy. The obtained results indicate the need to search for new methods of surgical treatment and to improve the technique of performing reconstructive plastic surgery of the foot in patients with wound defects of the foot.

In general, the high frequency of postoperative complications and the appearance of recurrent neurotrophic ulcers in the area of surgery in patients of the comparison group, regardless of adequate antibacterial and infusion therapy, required a deep retrospective analysis and the development of additional therapeutic measures aimed at improving postoperative results.

A lower percentage of primary healing after reconstructive plastic surgery and a high rate of repeated surgical interventions indicates the need to develop new methods of operations, taking into account the localization of purulent-necrotic lesions or wound defects on the foot and the features of anatomical structures in the foot departments. First of all, our attention was focused on the anatomical features of the foot parts and their role in changing biomechanics when walking.

Conclusions:

1. In the etiopathogenesis of the appearance of neurotrophic ulcers on the foot in patients with DM, the main role is played by a change in biomechanics due to a change in the foot reference point due to bone destruction. Timely adequate correction of the foot using the optimal method of reconstructive plastic surgery prevents possible postoperative complications in patients with purulent-necrotic lesions of the foot on the background of SDS.
2. The developed differentiated strategy for performing reconstructive plastic surgery, depending on the localization of the foot defect in patients of the main group (n=53), led to primary healing in 90.6% of cases ($p>0.05$), which is significantly more than in patients of the comparison group (70.9%). In this group of patients in the postoperative period, there was a low rate of the appearance of neurotrophic ulcers – 1.9% (in the comparison group 21.0%) ($p>0.05$).

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