COMPARATIVE ANALYSIS OF RESULTS OF TREATMENT OF PATIENTS WITH FOOT PATHOLOGY WHO UNDERWENT WEIL OPEN OSTEOTOMY BY CLASSICAL METHOD AND WITHOUT STEOSYNTHESIS

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Abstract

The article considers the problem of surgical correction of the second metatarsal bone length. The article analyzes the results of treatment of patients with excess length of the second metatarsal bones that underwent osteotomy with and without osteosynthesis. The results of treatment of patients who underwent metatarsal shortening due to classical Weil-osteotomy with and without osteosynthesis were analyzed. The first group consisted of 34 patients. They underwent classical Weil osteotomy. The second group included 44 patients in whom osteotomy of the second metatarsal bone were not by the screw. When studying the results of the treatment in the immediate postoperative period, weeks 6, 12, slightly better results were observed in patients of the first group, while one year after surgical treatment the results in both groups were comparable. One year after surgical treatment, there were 2.9% (1 patient) of unsatisfactory results in the first group and 4.5% (2 patients) in the second group. Considering the comparability of the results of treatment in remote postoperative period, the choice of concrete method remains with the operating surgeon.

Keywords: Flat feet; hallux valgus; corrective osteotomy; metatarsal bones.

I. Introduction

Deformations of the forefoot are quite common and diverse [V, VI, X, XIII]. One of the direct causes resulting in patients suffering may be the inharmonious structure of the forefoot, due to unfavorable from a biomechanical point of view correlation of metatarsal bones lengths [IV, VIII, IX]. Excessive length of some
metatarsal bones relative to others (most often there are disproportionately long second metatarsal bones) leads to chronic overload of the sole, which is located in the projection of the head of the corresponding metatarsal bone. This leads to areas of hyperkeratosis, often extremely painful, which are also called “corns” [II, VII, XII, XX]. Such a structure of the feet can lead to pathological gait with postural disorders and cause a persistent disturbance of walking biomechanics. Such changes, as a rule, can be compensated by the use of appropriate orthopedic devices that unload the overload zone. Such products include orthopedic insoles with silicone inserts, different hydrocolloid dressings, and special shoes. However, the patient is either doomed to move almost constantly with the help of additional devices, or (especially when combining this disorder with other deformations of the feet) have no effect at all from such a palliative, in fact, therapy.

Today, there are a large number of ways to determine the optimal relationship between the lengths of the metatarsal bones. The most well-known is the so-called "Lélevre parabola" (which is essentially an arch connecting the heads of the metatarsal bones) and Maestro "parameters (or criteria) based on this theory." These and similar calculations are made basing on x-ray data taken in direct projection under load and, in fact, do not consider the relative position of the metatarsal bone heads in the dorso-plantar direction [III, VII, XVI, XXI]. But even despite this fact, these calculations are quite valuable in practical terms.

To correct the length of 2 to 4 metatarsal bones (in great majority of cases their shortening is meant), a number of operations have been proposed. The most notorious are:

• Oblique Weil distal metaepiphyseal osteotomy
• Oblique distal metaepiphyseal osteotomy without osteosynthesis
• Osteotomy OCRA
• DMMO (distal metatarsal mini-invasive osteotomy)
• Reverse distal osteotomy Helal
• Proximal osteotomy, such as BRT

The latter of them are directed to the displacement of the heads of the metatarsal bones in the dorsal direction, but they have some resource for correcting the length [XVII].

Choice and use of a particular method for correcting the length of the metatarsal bones with a premorbid background, type and degree of deformation, the practicability of displacing the heads of the metatarsal bones in the dorsal direction, and functional requirements of the patient [I, XI, XIV, XIX].

In almost all cases of the inharmonious structure of the foot, the second metatarsal bone needs to be shortened, while the rest is much less common. In this regard, the main attentions in this work were given precisely to the second metatarsal bones.
In cases where there is no need for significant dorsal displacement of the heads of the metatarsal bones, and only shortening the second metatarsal bone is meant, Weil-osteotomy is the most convenient and well-recommended procedure [XV, XXII, XXIV]. Schematically, Weil-osteotomy is presented in Fig. one.

**Fig.1:** Scheme of Weil osteotomy

In its classical form this type of osteotomy implies osteosynthesis with one or two screws. However, it is possible to use this osteotomy without osteosynthesis with the condition for the correction of the postoperative period. Schematically, this type of osteotomy is presented in Fig. 2.
Fig. 2: Scheme of distal metaepiphyseal osteotomy of the second metatarsal bone without osteosynthesis.

The use of distal metaepiphyseal osteotomy of the second metatarsal bone without osteosynthesis may be of interest in cases where for some reason the use of submersible metal fixators is impossible [XVII, XXIII]. This type of osteotomy of the second metatarsal bone can be used in combined deformity correction, for example, in combination with SCARF osteotomy of the first metatarsal bone in Maestro modification.

II. Aim of the Study

To improve the treatment outcome for patients with anterior foot pathology by choosing the optimal method for surgical correction of the second metatarsal bone length.

To achieve the aim, the following tasks were set:

1. To analyze the results of treatment of patients with pathology of the feet, who underwent the distal metaepiphyseal oblique Weil osteotomy of the second metatarsal bone;

2. To analyze the results of treatment of patients with pathology of the feet, who underwent distal metaepiphyseal oblique osteotomy of the second metatarsal bone without osteosynthesis;

3. To determine the optimal surgical approach for correcting the length of the second metatarsal bone.

Object and research methods. The object of the study was patients operated on for deformation of the anterior foot in the trauma and orthopedic department No. 2 of the Samara State Medical University Clinics. From 2015 to 2018, 78 patients underwent surgical treatment for the correction of deformation of the forefoot (including osteotomy of the first metatarsal bone and shortening distal osteotomy of the second metatarsal bone). There were 73 (93.6%) women and 5 men (6.4%). The age of the patients ranged from 20 to 67 years.

The study included patients who objectively needed to shorten the second metatarsal bones.

Two groups of were formed. Only those patients who underwent intervention simultaneously on one foot including corrective osteotomy of the first metatarsal bone, and shortening distal osteotomy of the second metatarsal bone were included in the study. The first group consisted of 34 patients. They underwent classical Weil osteotomy. The second group consisted of 44 patients in whom osteotomy of the second metatarsal bone was not fixed with a screw.

In the postoperative period, all patients became active the day after surgery. Verticalization and activation of patients was carried out using postoperative shoes with unloading of the forefoot. All patients included in the study moved in two
identical boots despite the fact that only one foot was operated. In our opinion, this approach minimizes the risk of persistent postural disorders. In such shoes, patients of both groups moved within six weeks after the surgery.

In patients of both groups postoperative dressings were performed only according to indications. In patients of the first group, after the operation, a soft tissue bandage was applied in the neutral position of the toes. Patients of the second group had a soft tissue dressing applied in such a way as to provide maximum plantar flexion of the second toe. This manipulation provides sufficient contact to the fragments of the osteotomy bone and prevents the secondary displacement of the head of the metatarsal bone by the hematoma in the early postoperative period. On the third day after surgery dressing was made to all patients of the second group. During dressing, the excess plantar flexion of the second toe was corrected and the bandage was applied in the neutral position of the toe.

In both groups sutures were removed on the 14th day. After removing the sutures, dressings were not applied and patients were recommended hygienic treatment of the feet.

All patients from both groups were invited for follow-up examinations on 6, 12 weeks and 1 year after surgery. These terms of control examinations were due to the fact that 6 weeks after the operation, patients changed postoperative shoes to everyday shoes; after 12 weeks, fusion of osteotomized bones were expected, even considering the possibility of delayed consolidation; 1 year after the operation, the results were regarded as remote, taking into account the normalization of the gait and the functional state of the operated limb.

The method of comparison and grouping was used in the study to questionnaire patients of both groups (78 patients). To evaluate the results of treatment, the AOFAS scale was improved by adapting it to the specifics of the studied pathology.

The treatment results were evaluated as follows: excellent - 95-100 points; good - 75-94 points; satisfactory - 51-74 points; bad - 50 points or less. In assessing the patient's result of treatment within the framework of our improved scale, we used four-degree gradation (good, satisfactory, unsatisfactory, difficult to estimate). The assessment was carried out exclusively subjectively. The patient was recommended to consider the presence of pain, swelling, contractures, the degree of correction, the convenience of wearing shoes. When evaluating the result of treatment by the operated surgeon, three-degree gradation was used (good, satisfactory, and unsatisfactory). The assessment was made taking into account objective data, cosmetic and functional results. Besides, the degree and type of deformation before surgery and the amount of correction achieved were taken into account (Table 1).

| Pain (30 points)           | Absent | Moderate, rarely | Severe, daily | Very severe, constant |
|---------------------------|--------|-----------------|--------------|-----------------------|
| Pain in the field of intervention | 10     | 8               | 5            | 0                     |
| Metatarsalgia             | Absent |                 |              |                       |

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III. Results and Discussions.

When studying the immediate and remote results of treatment, it was found that in the immediate postoperative period on 6, 12 weeks, slightly better results were obtained in patients from the first group, while in a year the results were almost the same.

Considering the rather early follow-up, excellent and good treatment results were united.

Thus, analysis of the results 6 weeks after the intervention in the first group of patients showed 11.8% (4 patients) of excellent and good results, 67.6% (23 patients) – satisfactory and 20.6% (7 patients) – unsatisfactory results. In the second group, the figures respectively were: 6.8% (3 patients), 63.6% (28 patients) and 29.6% (13 patients). Unsatisfactory results at this time in both groups were primarily due to persisting postoperative oedema and pain syndrome both during exercise and at rest.

Assessment of the results of surgical treatment in the same groups of patients after 12 weeks showed that in the first group there were 50% (17 patients) of excellent and good results, 38.2% (13 patients) – satisfactory and 11.8% (4 patients) – unsatisfactory results. In the second group these figures respectively were: 47.7% (21 patients), 34.1% (15 patients) and 18.2% (8 patients). The negative results at this
follow-up period in both groups usually resulted from persistent oedema of the feet and the emerging contractures of the metatarsophalangeal joints.

Assessment of the remote results of treatment 1 year after the surgery showed that in the first group there were 85.3% (29 patients) of excellent and good results, 11.8% (4 patients) – satisfactory and only 2.9% (1 patient) – unsatisfactory results. In the second group these figures respectively were: 84.1% (37 patients), 11.4% (5 patients) and 4.5% (2 patients). Unsatisfactory results at this time were due to the migration of metal fixators, requiring repeated surgical intervention (1 case) in the first group of patients and the development of excess osteotylus in the osteotomy area and the formation of a pain syndrome similar to metatarsalgia (2 cases) in the second group.

It should be noted that in both groups of patients there were no registered case of non-union of bone fragments at the follow-up period of 12 months.

The following observation is presented as an example. Patient B., 60 years old, was admitted for surgical treatment to the traumatology and orthopaedic department No. 2 of Samara State Medical University Clinics in June 2018 with complaints of pain in the right foot, deformation of the foot, and difficulty in selecting and wearing shoes. The appearance of the foot before treatment is shown in Fig. 2.

Fig. 2: Patient B., 60 years old. The appearance of the right foot before surgery.

An x-ray was taken in direct projection under load (Fig. 3).
Fig. 3: Patient B., 60 years old. X-ray of the right foot in direct projection before surgery.

After preoperative planning, taking into account the clinical and radiological (Fig. 4) picture, surgical treatment was performed, which consisted of the corrective osteotomy of the first metatarsal bone according to SCARF type and distal metaepiphyseal osteotomy of the second metatarsal bone without metal fixator.
Fig. 4: Patient B., 60 years old. Preoperative radiography of the right foot. The appearance of the foot the day after the intervention is shown in Fig. 5.

Fig. 5: Patient B., 60 years old. The appearance of the right foot the day after surgery. In the early postoperative period (on the fourth day), control radiography was made (Fig. 6), where sufficient correction of the existing deformation was noted.

Fig. 6: Patient B., 60 years old. X-ray of the right foot in direct projection in the early postoperative period.
1 year after the intervention (Fig. 7), excellent functional result was noted.

**Fig. 7:** Patient B., 60 years old. The appearance of the right foot 1 year after the surgery.

**Fig. 7:** Patient B., 60 years old. The appearance of the right foot 1 year after the surgery.
No correction loss was detected in analysing the radiographs (Fig. 8), all osteotomies zones are consolidated. The patient has no complaints.

IV. Conclusion

Thus, basing on our experience in treating patients with anterior foot pathology who need correction of the length of one or several 2-4 metatarsal bones, we made a conclusion that in the remote period there is no significant difference between Weil osteotomy with or without osteosynthesis. However, in the early postoperative period, we noted more rapid restoration of foot function in the group of patients who underwent osteosynthesis.

Thus, both of these methods have the right to be used in clinical practice and in no case can be opposed to each other.

Considering the similarity of treatment results in the remote postoperative period, the choice of the method remains with the operating surgeon.

The use of the above methods of surgical treatment in remote observation period gives similar treatment results for patients who need correction of the length of 2-4 metatarsal bones, thus allowing to recommend them for widespread use in clinical practice.

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