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Rehabilitation of patients after surgical treatment of static deformities of the forefoot

D. V. Prozorovskiy [1], V. A. Staude [1], R. I. Buznytskiy [2]

[1] Sytenko Institute of Spine and Joint Pathology National Academy of Medical Sciences of Ukraine, Kharkiv
[2] Educational and Scientific Institute of Postgraduate Education of Kharkiv National Medical University. Ukraine

Postoperative rehabilitation of patients with hallux valgus is just as important, if not more so, than a technically flawless surgical intervention. Carrying out rehabilitation measures is an integral part of the postoperative period, which must be individual for each patient and depend on the volume and type of surgical intervention, the patient's age, and accompanying pathology. Objective. To improve the results of the recovery of patients after orthopedic surgical interventions on the front part of the foot due to the developed complex system of postoperative rehabilitation. Methods. The article provides an analysis of the results of treatment of 70 patients with transversely spread deformation of the forefoot and hallux valgus 1–2 degrees using different approaches to rehabilitation measures in the postoperative period. The patients were divided into 2 homogeneous groups by age, gender and degree of hallux valgus. Unlike the control group, manual therapy and myofascial massage techniques were additionally used in the main group. The results. The results of the treatment were evaluated according to the AOFAS scoring scale for the forefoot, which is generally accepted in the world. In the preoperative period, the average AOFAS score in the main and control groups was 65.4 and 64.7 points, respectively. 45 days after surgery, the average scores were 74.7 and 74.4 points, respectively. After 60 days, the average score in the main group was 92.1 points, and 82.6 in the control group. 3 months (90 days) after the surgical interventions, the average scores practically coincided in both groups and amounted to 93.7 points in the control group and 95.0 in the main group. The patients of the main group resumed their usual activities after 2 months. after the operation on the front part of the foot, and the control after 3 months. Conclusions. The use of myofascial massage, manual therapy for mobilizing the metatarsophalangeal and interphalangeal joints of the toes with gymnastics to strengthen not only the stabilizers of the foot, but also to restore the bearing capacity of the girdle of the lower extremities and the stereotype of walking, made it possible to obtain not only a positive functional result, but also to speed up the recovery compared to the control group per month.

Післяопераційна реабілітація пацієнтів з hallux valgus не менш важлива, ніж технічно бездоганно виконане хірургічне втручання. Реабілітаційні заходи є невід'ємною частиною післяопераційного періоду. Їх слід підбирати індивідуально залежно від обсягу та виду хірургічного втручання, віку пацієнта, супутньої патології. Мета. Поліпшити результати відновлення пацієнтів після ортопедичних хірургічних утручань на передньому відділі стопи за рахунок розробленої комплексної системи післяопераційної реабілітації. Методи. Проаналізовано результати лікування 70 пацієнтів із поперечно-розпластаною деформацією переднього відділу стопи та hallux valgus 1–2 ступенів. Хворих розподілили на 2 однорідні групи за віком, статтю і ступенем hallux valgus. Для корекції вальгусної деформації I пальця стопи застосовано коригувальні діафізарні остеотомії Scarf I плеснової кістки з фіксацією двома гвинтами Герберта. На відміну від контрольної групи, в основній додатково використано методики мануальної терапії та міофасціального масажу. Результати лікування оцінювали за бальною шкалою AOFAS для переднього відділу стопи. Результати. У передопераційному періоді в основній і контрольній групах за шкалою AOFAS середні показники дорівнювали 65,4 і 64,7 бала відповідно, через 45 діб після операції — 74,7 і 74,4 бала відповідно, через 60 діб — 92,1 і 82,6 бала. Через 90 діб після хірургічного втручання середні показники практично збігалися в обох групах і склали в контрольній 93,7 бала, в основній — 95,0. Пацієнтки основної групи відновили звичну життєдіяльність через 2 міс. після операції, а контрольної — через 3 міс. Висновки. Використання міофасціального масажу, мануальної терапії для мобілізації плесно-фалангових і міжфалангових суглобів пальців стоп із гімнастикою для зміцнення не лише стабілізаторів стопи, а й відновлення опороспроможності поясу нижніх кінцівок і стереотипу ходьби, дозволило отримати позитивний функціональний результат, пришвидшити відновлення порівняно з контрольною групою на місяць. Ключові слова. Післяопераційна реабілітація, статичні деформації переднього відділу стопи, hallux valgus.

Key words. Postoperative rehabilitation, static deformations of the foot, *hallux valgus*

Introduction

Transversely distributed deformity of the front part of the foot with hallux valgus occupies a special place due to numerous disorders, the number of which is increasing recently, the progressive nature and the relationship with persistent disorders of a number of locomotor functions. It is most often diagnosed in women — 75 % of cases [1]. Postoperative rehabilitation of patients is just as important, if not more so, than a technically impeccably performed intervention. A positive functional result of the treatment is achieved not only through skillfully performed surgical procedures, but also under the condition of an individually developed and selected system of postoperative restorative treatment. Carrying out rehabilitation measures is an integral part of the postoperative period; they should be individual for each patient and depend on the age, volume and type of surgical intervention, and presence of concomitant diseases.

Most often, surgical treatment of the front part of the foot is performed in case of static deformity (*hallux valgus*, hammertoe deformity, arthrosis of the foot joints, etc.) [1]. To correct certain distortions of this localization, various types of corrective osteotomies with fixation of bone fragments with needles, screws or plates, as well as arthroplasty are mostly used [2]. Distal, diaphyseal, and proximal metatarsal osteotomies are most commonly used to correct deformity, or to restore congruence of articular surfaces [3, 4].

Modern canons of orthopedics provide for the use, on the one hand, of low-traumatic surgical techniques, and on the other hand, stable fixation of bone fragments with early rehabilitation of the patient. Unfortunately, these parameters are difficult to combine into a single whole due to the small size of the available metal fasteners and the significant load that falls on the sole surface of the foot. However, a developed plan of rehabilitation measures, taking into account the biomechanical role of stabilizer muscles not only of the front part of the foot [5], but also those that determine the bearing capacity and stability of the entire lower limb belt [6], helps to avoid these problems in the postoperative period. The rehabilitation program developed by us is aimed at functional restoration of the capsular-ligamentous and muscular apparatus of the operated foot.

Rational postoperative support of patients ensures a favorable long-term result. Moreover, for a more successful perception by patients of information in terms of recommendations, these provisions should be communicated to them before performing surgical intervention.

Purpose: to improve the results of recovery of patients after orthopedic surgical interventions on the front part of the foot due to the developed complex system of postoperative rehabilitation.

Material and methods

The materials were reviewed and approved by the local Bioethics Committee at the State Institution Professor M. I. Sytenko Institute of Spine and Joint Pathology of the National Academy of Medical Sciences of Ukraine (Protocol No. 220 dated 18.10.2021). Informed consent was obtained from all patients included in the study.

The study involved assessment of the immediate and long-term outcomes of treatment of 70 patients with transversely spread deformation of the forefoot and *hallux valgus* grades 1–2 according to the Mann classification [7].

They were divided into two homogeneous groups according to age, gender and degree of *hallux valgus*, which further made it possible to correctly compare the results of treatment using different approaches to rehabilitation measures in the postoperative period.

The main group included 35 women; the age at the time of hospitalization was from 18 to 56 years, with *hallux valgus* 1 and 2 degrees, M1/M2 angle from 9º to 13º and M1/P1 angle from 17º to 26º.

The control group consisted of 35 women aged 19 to 55 years with *hallux valgus* 1 and 2 degrees, M1/M2 angle from 9º to 13º and M1/P1 angle from 15º to 26º.

To correct the valgus deformity of the 1st toe, corrective diaphyseal osteotomies of the 1st metatarsal bone with two Herbert screws were used. All patients underwent osteotomies in combination with Schede's operation and lateral release of the 1st metatarsophalangeal joint.

Both in the main and in the control groups, postoperative support began immediately after the end of the surgical intervention by applying an adhesive elastic Coban bandage to the front and middle parts of the foot, which allowed to keep the toes in the corrected position and prevented the development of postoperative edema due to the creation of moderate compression of soft tissues (Fig. 1).

Cold therapy was used on the first day after surgery for the purpose of additional hemostasis and prevention of the development of edematous syndrome. On the day after surgery, patients were allowed to walk in Barouk shoes (Fig. 2), which promotes full loading of the operated limb (excluding the front part

and transferring it to the rear part of the foot). This effect arose due to the design feature of the shoes, which were worn for 4 to 6 weeks depending on radiological control, that is, the degree of bone callus formation.

At the same time, patients were prescribed physiotherapeutic treatment aimed at the prevention and reduction of postoperative edema and the reduction of the risk of inflammatory complications (UHF, magnetic therapy). In addition, therapeutic exercises aimed at performing active movements in the supracalcaneal joint and foot joints (inversion and eversion) were added, which also contribute to the minimization of swelling. Passive movements in the operated joints of the foot were allowed from the 5th to the 7th day after the operation. Active movements could be started from the 3rd to 40th week after the operation. The gymnastics complex included exercises to strengthen the endurance of the entire girdle of the lower limbs and restore the gait stereotype [6].

Unlike the control group, manual therapy and myofascial massage techniques were additionally used in the main group. The latter involved performing massage movements until pain appeared: deep stroking, rubbing and kneading. Its main goal was to affect myofascial trigger points, which are formed in the muscles and ligaments of the foot stabilizers [8] and can result in their dysfunction and pain [9].

With the help of myofascial massage, the action was aimed at the capsule-ligamentous apparatus of the joints of the toes, plantar aponeurosis, *tendons m. flexor hallucis longus* and *m. extensor hallucis longus, m. adductor hallucis, m. abductor hallucis,* transverse and oblique head*, m. extensor digitorum brevis*. Myofascial massage was performed on

Fig. 1. Elastic bandage on the front and middle parts of the foot in the postoperative period

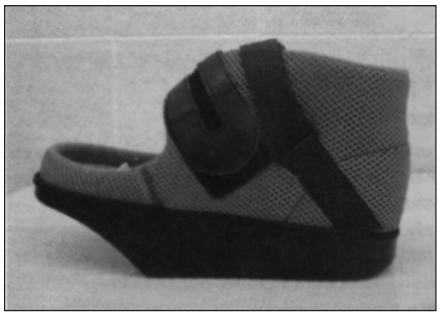

Fig. 2. Barouk shoes

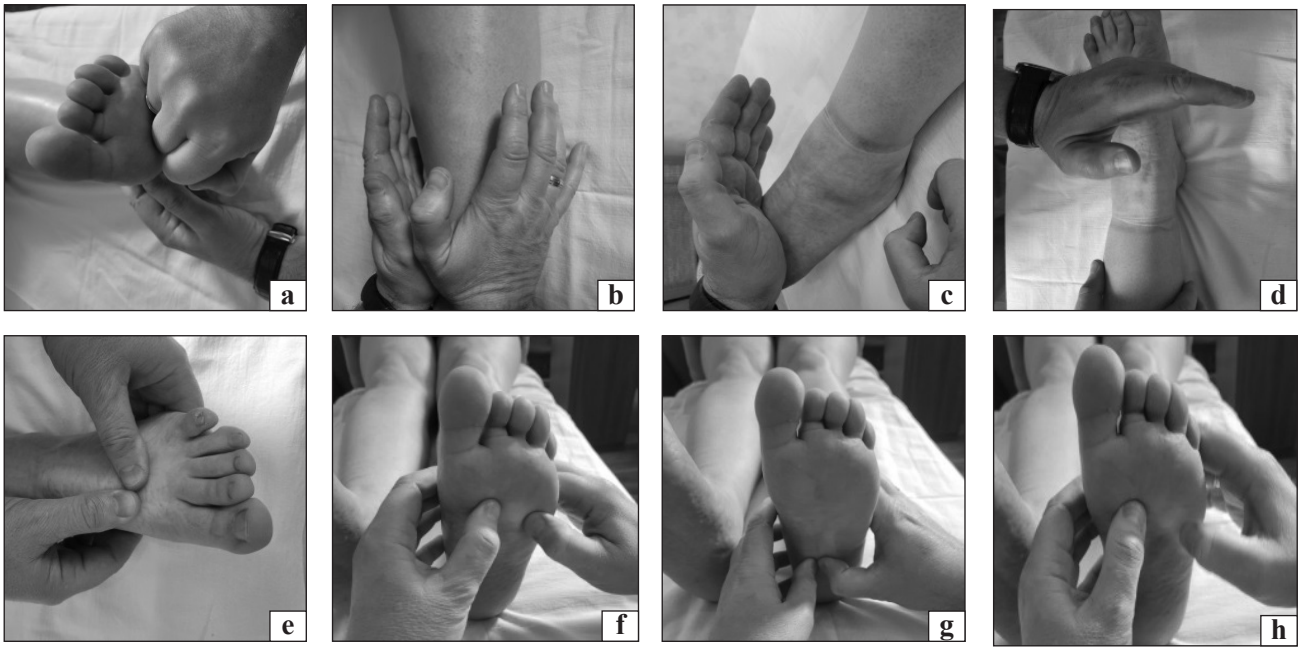

Fig. 3. Technical elements of myofascial massage: deep rubbing of the plantar aponeurosis (a); deep kneading of *m. tibialis anterior, m. fibularis longus, m. flexor hallucis longus, extensor hallucis longus* (b); deep rubbing (c) and kneading (d) of *m. extensor digitorum brevis*; deep kneading and rubbing of tendons *m. extensor hallucis longus* and capsules of metatarsophalangeal joints with their mobilization (e), of *m. adductor hallucis,* transverse and oblique head with mobilization of the metatarsal-phalangeal joints (f); deep kneading of *m. abductor hallucis* (g) and tendons *m. flexor hallucis longus* (h)

the lower legs *m. tibialis anterior, m. fibularis longus, m. flexor hallucis longus, extensor hallucis longus*, which makes it possible to accelerate the restoration of the bearing capacity of the entire girdle of the lower limbs [10]. Technical elements of myofascial massage are shown in Fig. 3.

Manual therapy involved mobilization of the metatarsal-phalangeal and interphalangeal joints of the toes with slight stretching of its capsular-ligamentous apparatus.

Mobilization was performed in the position of the patient on the back or stomach for the distal segment from the joint, provided that the proximal segment was fixed, with the mandatory use of axial traction. Displacement was performed in anteroposterior and lateral directions, then flexion and extension, lateral deviation, and rotation were added.

An important aspect of successful rehabilitation was teaching patients procedures for self-mobilization of the toe joints, the technique of which is quite simple and easy to implement: the operated limb, bent at the knee and hip joints, is adducted and turned outward (without adduction, the tension of the extensors of the foot and hybrid toes is maintained). The metatarsal bones are alternately fixed with the ipsilateral hand, mobilization is carried out with the contralateral hand, and the directions of movement should repeat the main directions of the joint with an emphasis on extension in the metatarsophalangeal joint I and on flexion in II, III, IV and V (Fig. 4).

The course of myofascial massage was started 4 weeks after the operation and was performed daily for 10 days. In most cases, this number of sessions was enough to significantly reduce pain and swelling of the soft tissues of the operated foot. After the massage, the patients performed the described gymnastics with the addition of exercises to restore the endurance of the entire lower limb and stereotyped walking for 20 minutes. To preserve the result and improve it, patients were taught to perform gymnastics independently.

After the end of the period of using Barouk shoes, the patients were made individual orthopedic insoles with longitudinal and transverse arches.

Results and their discussion

We evaluated outcomes of treatment in patients with deformities of the front part of the feet, who underwent the same types of surgical interventions under the same nosological forms. The difference was only in the tactics of the postoperative period. In the control group of patients (35 women), the traditional method of postoperative rehabilitation was used, and in the main group (35 female patients), in addition to the traditional method, the elaborated tactics using myofascial massage, manual therapy, therapeutic and independent gymnastics were used.

Fig. 4. Independent mobilization of the 1st metatarsophalangeal joint according to L. S. Barouk [11]

Table

Comparative results of pre- and postoperative treatment in the main and control groups according to the AOFAS scale

Period after operation (day)	Main group (score)	Control group (score)
Before operation	65.4	64.7
45	74.7	74.4
60	92.1	82.6
90	95.0	93.7

The results of treatment were evaluated according to the internationally accepted AOFAS forefoot scoring scale (module 2) [12] 45, 60 and 90 days after surgery. It was determined that in the preoperative period in both groups, the average score on the AOFAS scale was 65.4 and 64.7 points, respectively. 45 days after the operation, the average values were equal to 74.7 and 74.4 points, respectively. After 60 days, the average score in the main group was 92.1 points, and 82.6 in the control group. 90 days after the surgical interventions, the average scores were comparable and were equal to 93.7 points in the control group and 95.0 in the main group (Table).

The patients of the main group resumed their usual activities 2 months after the operation on the front part of the foot, and the control group individuals after 3 months. Currently, we can note the positive impact of the proposed rehabilitation technique for the fastest possible functional recovery.

Conclusions

Adequate rehabilitation in the postoperative period is important to obtain a good result after ortho-

pedic surgery on the front part of the foot in patients with static deformities.

The use of myofascial massage, manual therapy for the mobilization of the metatarsophalangeal and interphalangeal joints of the toes with gymnastics to strengthen not only the stabilizers of the foot, but also to restore the bearing capacity of the girdle of the lower limbs and the stereotype of the gait, made it possible to obtain a positive functional result and speed up the recovery compared to the control group for a month.

Conflict of interest. The authors declare no conflict of interest.

References

1. Roddy, E., Zhang, W., & Doherty, M. (2008). Prevalence and associations of hallux valgus in a primary care population. *Arthritis and rheumatism, 59*(6), 857–862. https://doi.org/10.1002/art.23709.
2. Buckenberger, R. K., & Goldman, F. D. (1995). Chevron bunionectomy fixation: in vitro stability assessment of plate-and-screw system compared with Kirschner wire. *The Journal of foot and ankle surgery : official publication of the American College of Foot and Ankle Surgeons, 34*(3), 266–272. https://doi.org/10.1016/S1067-2516(09)80058-6
3. Kroitoru, G. M., Betishor, V. K., & Darchuk, M. I. (2003). SCARF osteotomy in the surgical treatment of valgus deformity of the first toe. *Orthopedics, Traumatology and Prosthetics*, (3), 113–114. (in russian)
4. Khlopas, H., & Fallat, L. M. (2020). Correction of hallux abducto valgus deformity using closing base wedge osteotomy: a study of 101 patients. *The Journal of foot and ankle surgery: official publication of the American College of Foot and Ankle Surgeons, 59*(5), 979–983. https://doi.org/10.1053/j.jfas.2020.04.007
5. Heineman, N., Liu, G., Pacicco, T., Dessouky, R., Wukich, D. K., & Chhabra, A. (2020). Clinical and imaging assessment and treatment of hallux valgus. *Acta radiologica (Stockholm, Sweden: 1987), 61*(1), 56–66. https://doi.org/10.1177/0284185119847675
6. Myers, T. (2020). Anatomic trains. Myofascial meridians for manual therapists and specialists in regenerating movement. Anatomy trains. Churchill Livingstone Elsevier.
7. Mann, R. A. (1999). Adult hallux valgus. In R. A. Mann, M. J. Coughlin (Eds.), *Surgery of the foot and ankle* (pp. 151–267). 7th ed. St. Louis: Mosby.
8. Bethers, A. H., Swanson, D. C., Sponbeck, J. K., Mitchell, U. H., Draper, D. O., Feland, J. B., & Johnson, A. W. (2021). Positional release therapy and therapeutic massage reduce muscle trigger and tender points. *Journal of bodywork and movement therapies, 28*, 264–270. https://doi.org/10.1016/j.jbmt.2021.07.005
9. San-Antolín, M., Rodríguez-Sanz, D., Becerro-de-Bengoa-Vallejo, R., Losa-Iglesias, M. E., Casado-Hernández, I., López-López, D., & Calvo-Lobo, C. (2020). Central Sensitization and Catastrophism Symptoms Are Associated with Chronic Myofascial Pain in the Gastrocnemius of Athletes. *Pain medicine (Malden, Mass.), 21*(8), 1616–1625. https://doi.org/10.1093/pm/pnz296
10. Staude, V., Romanenko, K., Radzyshevska, Ye., Prozorovskyi, D., Staude, A. (2023). Rehabilitation treatment for patients with post-traumatic deformities of long bones of lower extremities in the long term after trauma. *Journal of Physical Education and Sport, 23*(3), 738-747. http://dx.doi.org/10.7752/jpes.2023.03091
11. Ilchenko, D. V., Kardanov, A. A., Karandin, A. S., & Korolev, A. V. (2017). Rehabilitation methods after surgical treatment of the static foot deformities. *Journal of experimental and Clinical Surgery, 10*(1), 54–63. https://doi.org/10.18499/2070-478X-2017-10-1-54-63
12. Cook, J. J., Cook, E. A., Rosenblum, B. I., Landsman, A. S., & Roukis, T. S. (2011). Validation of the American College of Foot and Ankle Surgeons Scoring Scales. *The Journal of foot and ankle surgery : official publication of the American College of Foot and Ankle Surgeons, 50*(4), 420–429. https://doi.org/10.1053/j.jfas.2011.03.005

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REHABILITATION OF PATIENTS AFTER SURGICAL TREATMENT OF STATIC DEFORMITIES OF THE FOREFOOT

D. V. Prozorovskiy [1], V. A. Staude [1], R. I. Buznytskiy [2]

[1] Sytenko Institute of Spine and Joint Pathology National Academy of Medical Sciences of Ukraine, Kharkiv
[2] Educational and Scientific Institute of Postgraduate Education of Kharkiv National Medical University. Ukraine

✉ Dmytro Prozorovskiy, MD, PhD in Traumatology and Orthopaedics: prozorovskiy1973@gmail.com
✉ Volodymyr Staude, MD, DM Sci. in Traumatology and Orthopaedics: staudevl@gmail.com
✉ Ruslan Buznytskiy, MD, PhD in Traumatology and Orthopaedics: ruslan3buz@gmail.com