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Surgical treatment of Hallux extensus

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Abstract

Introduction This study is a comparative assessment of early and long-term results of two different methods of surgical treatment of hallux extensus. **Materials and methods** The results of surgical treatment of 22 patients with Hallux extensus at the orthopedic department of the Moscow Yudin City Hospital from 2017 to 2019 were studied. The patients were divided into 2 groups depending on the tactics of surgical treatment. The main goal of this study is a comparative assessment of the functional results of two surgical techniques. The first group of patients, which included 11 subjects, underwent needle percutaneous tenotomy of the extensor tendon of the big toe, the second group, which also consisted of 11 people, underwent tenodesis of the tendon-muscular part of the short flexor of the big toe according to the proposed by us technique. **Results** The study results are based on the assessment of subjective patient satisfaction and radiography images, as well as on the ACFAS score. In the group of patients who underwent percutaneous tenotomy of the extensor tendon of the big toe, there was a recurrence of deformity in 4 patients (36 %) and insufficient correction of the deformity in 2 patients (18 %). In the group of patients who underwent tenodesis of the tendon-muscle part of the short flexor of the big toe, 100 % showed good functional results, pain relief and esthetic effect. Good treatment results were observed in 73.3 % of the patients. **Conclusions** Analysis of the clinical results of surgical treatment showed a high efficacy of tenodesis of the tendon-muscle part of the short flexor of the big toe in comparison with percutaneous tenotomy of the extensor tendon of the big toe. Positive results were achieved in 100 % of cases. No recurrence of deformity was observed. The patients did not complain of pain, and there were no problems with footwear in the postoperative period.

Keywords: metatarsophalangeal joint, Hallux extensus, Hallux valgus

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INTRODUCTION

Hallux extensus is characterized by dorsal displacement and subluxation of the metatarsophalangeal joint of the big toe. The disease is based on any condition that gives advantages to the extensor tendons over the flexor tendons. In the literature, this pathology can be found under the names floating toe, ski-jump toe, cockup deformity, or turf toe (Fig. 1) [1–3].

The relevance of this problem is due to a significant decrease in the quality of life of this group of patients, associated with a permanent minor pain syndrome, problems with footwear choice, instability while walking and running, and, as a result, a progressive impairment of walking and support functions [1]. Hallux extensus is accompanied by adaptive flexion deformity in the interphalangeal joint of the big toe. Chronic sesamoiditis can also be the result of increased plantar pressure. In the long term, the disease is complicated by arthrosis of the first metatarsophalangeal joint [1, 2, 4, 5].

The development of Hallux extensus was previously attributed, first of all, to neurological disorders, in particular, neuromuscular imbalance after cerebrovascular pathology, neuromuscular diseases such as Charcot-Marie-Tooth disease, static or peroneal paralysis with "foot drop" (cockup deformity).

Fig. 1 Iatrogenic extension deformity of the big toe

Also, injuries of the plantar plate of the first MTP joint (turf toe), plaster immobilization, trauma or iatrogenic removal of the sesamoid complex, wearing high-heeled shoes in a BMI higher than 38, chronic inflammatory diseases of the capsular-tendon complex of the metatarsophalangeal joint of the big toe (tendovaginitis extensor hallucis longus) may result in extension [6–13]. Due to the improvement of the techniques of surgical treatment for Hallux valgus, the number of operations has also increased, and allowed iatrogenic causes of extension to come to the fore [14].

The basic surgical technique for correcting static deformity of the forefoot is osteotomy of the first metatarsal bone. Among numerous variants of this operation, scarf osteotomy is often preferred in clinical practice. The popularity of this technique is associated with its ability to correct the deformity of the first metatarsal bone in three planes. According to some authors, the lack of understanding of the spatial orientation of the first metatarsal and the concept of osteotomies can lead to excessive shortening and/or reduction of the first metatarsal (M1) in forefoot reconstruction [14–20]. To eliminate valgus deformity of the big toe, the main point is shortening of the first metatarsal bone. Underestimation of the length of M1 and M2 during preoperative planning may be the main cause of iatrogenic extension. Excessive shortening leads to a decrease in the function of the short flexor, of which the sesamoid complex is an integral part. The result is that the function of the extensor tendons of the big toe prevails over the function of the flexor tendons. There is tension and dorsal displacement of the distal phalanx, and the first toe takes on a characteristic position. The restoration of the short flexor is pathogenetically substantiated tactics of surgical treatment of this pathology.

The condition is easily diagnosed in most cases. Manifestations of this pathology can vary from aesthetic and visual discomfort, permanent lifting of the big toe and the subsequent traumatic and fungal lesion of the nail bed, to pain in the first MTP joint as a result of arthrosis progression. Patients complain of persistent pain in the area of the metatarsophalangeal joint by wearing shoes. Later, they experience difficulties in choosing them. Some patients note disorders in the static-dynamic function during walking and running [1, 2].

The instrumental diagnostic methods are predominantly radiography and MRI. The latter provides spatial perception of bone landmarks and a detailed study of soft tissues, which is especially important in cases of extensor deformity caused by trauma. Accurate determination of involved structures and injury severity using MRI is the basis for treatment [1, 21–23].

The conservative methods for the treatment of this pathology, including the manufacture of special shoes that exclude trauma to the nail bed, fabrication of orthotic insoles with a metatarsal roller that reduces the overload of toes 2-3-4, fixative and semi-rigid orthoses are only temporary measures to alleviate the symptoms of the disease. Surgical methods are the main ones in the treatment of Hallux extensus [1–3, 24].

Purpose To compare the results and evaluate the efficiency of treatment with two surgical techniques for correction of iatrogenic Hallux extensus.

MATERIALS AND METHODS

We analyzed the results of surgical treatment for Hallux extensus in 22 patients at the Foot Surgery Center of the Yudin GKB (Moscow) from October 2017 to May 2019.

The criterion for inclusion in the study was surgical treatment of patients with extension deformity of the big toe. The study did not include patients with recurrence of valgus deformity of the big toe that required further correction.

The study was performed in accordance with the ethical principles of the Declaration of Helsinki (World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects, 2013). All patients signed a voluntary informed consent for surgical intervention.

In all the patients, the extension of the big toe was due to iatrogenic effects after the treatment of Hallux valgus. The mean age of the patients was 47.7 years. All patients were women.

The results were evaluated according to the system of the American College of Foot and Ankle Surgery (ACFAS).

The patients were divided into groups based on the method of surgical treatment used. Group 1 included 11 patients who underwent percutaneous needle tenotomy of the big toe extensor and capsulotomy of the metatarsophalangeal joint of the toe. The skin was punctured with a needle or a thin scalpel in the projection of the extensor tendon at the level of the metatarsophalangeal joint, then a complete intersection of the tendon with dissection of the joint capsule and further manual immobilization of the first metatarsophalangeal joint and subsequent fixation with kinesiotape were performed.

The second group also consisted of 11 people. A different surgical technique was used in them. It was the method of surgical correction of extension deformity of the big toe [25] proposed by us (patent for invention No. 2736907 dated November 23, 2020). A skin incision was made along the medial surface of the metatarsophalangeal joint, the site of attachment of the abductor tendon was identified, the tendon was exposed (Fig. 2). Next, the proximal end of the tendon was dissected longitudinally in the

proximal direction to the muscle portion and a split graft was formed (Fig. 2). The size of the dissected tissues was determined in such a way as to ensure the necessary plantoflexion of the toe and its subsequent secure fixation. The formed part of the tendon flap of the abductor was transferred through the muscle portion of the short flexor of the big toe in the plantar direction, followed by fixation to the plantar part of the capsule of the cuneo-metatarsal joint in the position of correction of the big toe with interrupted or continuous sutures (Fig. 3).

From the 1st post-op day, the patients were recommended loading on the foot in special shoes with a changed center of gravity (Baruk type shoes). After 3 weeks, manual mobilization was started in the 1st MTP joint, and 6 weeks after the operation, walking in regular shoes was allowed.

Methods of outcome evaluation

In the course of inpatient treatment, the results of surgical techniques were evaluated clinically (elimination of extension of the big toe). After discharge, the patients were invited for follow-up examinations at 1, 5, 3, and 6 months after surgery. At follow-up visits, functional outcomes were assessed with the ACFAS system (Table 1) and cases of deformity recurrence were recorded.

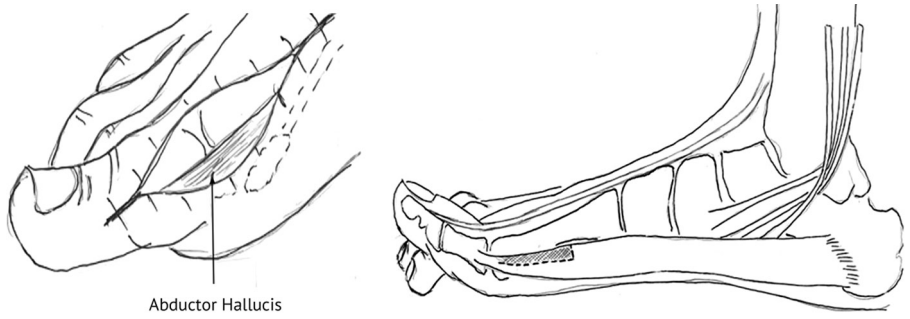

Fig. 2 Approach to the abductor tendon of the big toe and creation of the flap

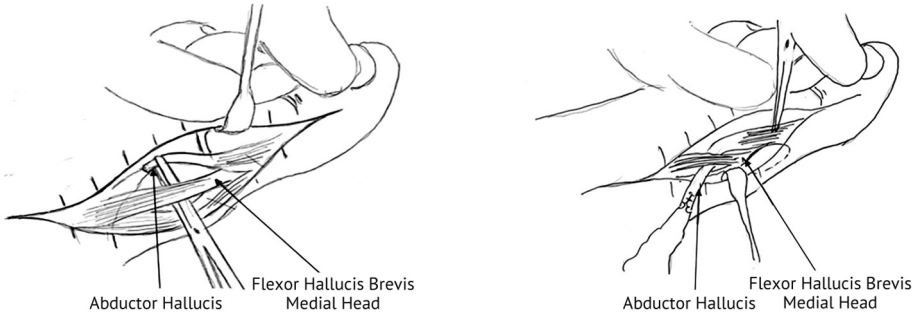

Fig. 3 Flap transfer through the head of the flexor brevis of the big toe and its fixation

Table 1

ACFAS evaluation

Type of assessment	Before surgery, points		After surgery, points	
	Group 1	Group 2	Group 1	Group 2
Subjective	27.1	27.1	36.8	48.5
Objective	30.2	30.2	40.1	49.8

RESULTS

The follow-up observation was 10–22 months. At the follow-up after 8 weeks, recurrence of the deformity was noted in 4 patients and insufficient elimination of the deformity in 2 patients in the first group. Patients experienced pain, inconvenience by wearing shoes and a cosmetic defect. In patients of the 2nd group, after 8 weeks, an excellent esthetic and functional result was recorded. A good result was noted at the follow-up after 6 months. No recurrence of the deformity was observed. Good results of treatment were recorded in 73.3 % of operated patients.

DISCUSSION

Currently, many surgical techniques have been proposed for correction of Hallux extensus, including the methods based on tendons, bone and combined methods for eliminating deformities associated with osteotomies at various levels and arthrodesis of the joints. Most of the methods include arthrodesis of the distal joints of the 1st ray. Machacek F. Jr et al. described the results of arthrodesis of the first metatarsophalangeal joint, which was performed for extension of the big toe after osteotomy of the first metatarsal bone. The follow-up period was

36 months, and a total of 28 patients (29 feet) participated. Fusion was achieved in 26 cases. Repeated arthrodesis was performed in 5 cases due to incorrect position and pseudarthrosis [18]. An undoubted disadvantage of arthrodesis of the metatarsophalangeal joint is long-term plaster immobilization in the postoperative period, 2–3 months on average, necessary for the fusion of the bone block, and subsequently, as a result of overload, arthrosis of the metatarsophalangeal joint progresses, and is accompanied by persistent pain [26, 27]. Berezhnoy S. Yu. [28] proposes to perform a lengthening tenotomy of the long extensor of the big toe at the level of the interphalangeal joint, and in the case of a pronounced deformity, a dorsal capsulotomy of the interphalangeal joint in combination with osteotomy P1 open angle to the rear of the foot. McGowan D. [29] in his study also recommends tenotomy of the long extensor tendon of the big toe at the level of the interphalangeal joint as the choice method for correcting Hallux extensus. Acero Caballero J. et al. from the Hospital de Jerez de la Frontera [30] at the 55th SICOT congress reported a percutaneous tenotomy of the long extensor of the big toe finger combined with a dorsal capsulotomy in a 51-year-old man with Hallux extensus with a very good functional and esthetic result.

Petrosyan A.S. [5] also suggests performing a minimally invasive percutaneous tentotomy of the long extensor tendon or, as an alternative, an open operation of Z-shaped lengthening of the long extensor tendon and tenotomy of the tendon of the short extensor for the purpose of correcting iatrogenic Hallux extensus. In cases where hyperextension was caused by dorsiflexion of the head of the first metatarsal bone, its corrective osteotomy was performed. However, the disadvantages of these methods of surgical treatment were:

1) continuous long-term postoperative monitoring of the patient and dressings performed by qualified personnel;

2) the risk of incomplete elimination of the deformity, as well as the recurrence of Hallux extensus due to an uncontrolled adhesive process, which further would require a repeated open intervention;

3) by eliminating extension with percutaneous teno- and capsulotomy, it is not always possible to achieve a complete correction of this pathology, and there is also no permanent stable position of the distal fragment in the corrected state;

4) due to increased trauma in performing arthrodesis and working with bone-tendon complexes, there is a risk of developing aseptic and septic complications, that would further lead to the occurrence of extensive postoperative adhesions and strictures [5, 29, 31].

The method for correcting extension proposed by us enable to visually control the fixation point of the abductor tendon flap and the required position of the toe by forming a split flap from the tendon part of the abductor and passing it through the muscle portion of the short flexors of the big toe with subsequent fixation to them. Tension of the tendon flap of the abductor eliminates the extension deformity. In addition, during the operation, no radical osteotomies and arthrodesis of the joints are performed, and there is no need to use expensive fixators. Prevention of deformity recurrence is ensured by the stable position of the nail and middle phalanges of the big toe that are firmly fixed with the help of a split part of the abductor tendon. This method allows for an early load on the limb and, most importantly, recovers the pushing off function of the big toe, ensures the safety of the static-dynamic function.

CONCLUSIONS

The analysis of the clinical results of surgical treatment showed high efficiency of tenodesis of the tendon-muscle part of the short flexor of the big toe in comparison with percutaneous tenotomy of the extensor tendon of the big toe. The method of surgical treatment of Hallux extensus, we propose, allowed us to achieve excellent functional results in 100 % of patients. In the group of patients who underwent percutaneous extensor tendon tenotomy, the complications were deformity recurrence and insufficient deformity correction in 6 patients (54 %).

Tenodesis of the tendon-muscular part of the short flexor of the big toe ensures reliable elimination of the extension of the big toe, preserves the pushing function of the 1st ray, and guarantees the absence of deformity recurrence in comparison with the technique of percutaneous teno- and capsulotomy. Thus, the proposed method of surgical correction of the deformity of the big toe is a fairly effective method of surgical treatment and requires further study.

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