

## **Errors and complications in management of primary long bone tumors in the lower limbs with the Ilizarov transosseous osteosynthesis**

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**Introduction** The Ilizarov method of non-free bone plasty has been widely used for management of lower limb long bones after resection of primary tumors. Analysis of errors and complications by using this method is a demanded and relevant task. Purpose We retrospectively studied the errors and complications by using the method of Ilizarov non-free bone topasty in patients with primary neoplasms in lower limb long bones. **Material and methods** Rehabilitation of 133 patients with primary tumors of lower limb long bones was analyzed. All of them were treated with the Ilizarov method of compression-distraction osteosynthesis for bridging post-resection defects. **Results** Our retrospective study revealed organizational, tactical, technical errors and complications, which we observed during clinical and rehabilitation stages. **Conclusion** Systematization of errors and associated complications allowed us to develop recommendations for their prevention and treatment.

**Keywords:** transosseous osteosynthesis, tumors of long bones of lower limbs, errors, complications

### INTRODUCTION

When limb reconstruction as well as the effectiveness of non-free bone grafting with the Ilizarov apparatus to manage bone tissue defects formed is considered, the surgeons are aware of long-term external fixation, loss of quality of life, development of contractures in the adjacent joints and local soft tissue inflammation at the stages of treatment [1-7]. Ilizarov transosseous osteosynthesis has found application and proved to be effective in restoring the integrity of limb segments in patients with primary neoplasms of long bones [8-14]. According to literature search, studies that address the issues of restoring the integrity of the limb in patients

with primary neoplasms in lower limb long bones are not numerous while investigations of the arising complications and their causes during the treatment are not available. In our opinion, an analysis of errors and complications of the Ilizarov non-free bone plasty in patients with tumors in lower limb bones is in demand and is relevant.


The aim of this work was to retrospectively study the errors and complications of the application of the Ilizarov method of non-free bone oplasty in patients with primary neoplasms in long bones of the lower limbs.

### MATERIAL AND METHODS

We studied the treatment results of 133 patients with primary tumors of long bones in the lower limbs aged 10 to 50 years with a morphologically verified diagnosis of primary bone tumors. The study was approved by the Ethics Committee. Methods of descriptive statistics were used. Statistical processing of data was carried out using the "BIOSTAT" and "Microsoft Office Excel 2010 for Windows 7" software. To describe the nature of the distribution of quantitative characteristics, mean values (M) and standard deviations (SD) were determined. Analysis of quantitative data was carried out using

nonparametric criteria, qualitative –  $\chi^2$ . Differences were considered statistically significant at  $p < 0.05$ .

Male patients were 51 (38.3%), female – 82 (61.7%). Children aged 10 to 17 years were 39 (29.3%). Average age of the group was 22 years. Thirty patients (22.6%) had malignant bone tumors, 103 (77.4%) had benign ones. Segmental resection of the affected area in bone was performed at the surgical stage of the treatment. Bone defects formed were from 5 to 22 cm in size. They were bridged by regeneration at one or several levels using variants of mono- and polyfocal lengthening of fragments, lengthening

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of adjacent segments and interosseous synostosis. According to the indications, 30 patients (22.6 %) with malignant bone tumors received neoadjuvant

chemotherapy according to the methods developed at N.N. Blokhin RSOC of RAMS. Long-term outcomes were studied after 3 to 20 years.

## RESULTS

We revealed and analyzed the main groups of errors: organizational 36 (27.0 %), tactical 11 (8.3 %), and technical 17 (12.8 %) ones. Based on the analysis of errors, the associated medical complications were studied (24, 18.0 %).

**Organizational errors** In the preoperative period, the choice of the diameter of ring and arch supports without taking into account the minimum distance from the surface of the skin to the inner edge of the ring (arch) was one of errors. This error was detected in 5 cases (3.8 %). The delay in the reassembly of the apparatus without objective reasons led to an increase in the period of osteosynthesis by one to 2 months in 9 patients (6.8 %). Due to incorrect position of patients in the bed and exercise therapy negligence, 13 patients (9.8 %) developed combined contractures of the hip and knee joints. Violation of the evaluation of the limb state and recommendations for increasing functional load on the limb caused deformation of the distraction regenerate in two patients (1.5 %).

**Tactical errors** In the early stages of planning and implementation of limb-salvage surgeries for long bone tumor with transosseous osteosynthesis, indications for the use of this method were inadequately established in 6 patients (4.5 %) with primary malignant neoplasms. Objective examination of these patients revealed a significant tumor size (more than 10 cm), its rapid growth rate (more than 1 cm/month), slight regression due to pre-operative chemotherapy (grade I-II of therapeutic pathomorphosis), and history of pathological fracture (3 patients). All these factors reduced the likelihood of a favorable outcome of the salvage operation due to oncologic aspects and the expediency of performing amputation had to be considered. Substitution of post-resection bone defect

ran as delayed distraction regenerate reorganization and prolonged the treatment time in 3 patients (2.3 %). Wrong choice of the fragments ends coaptation technique was in 3 patients (2.3 %) who underwent bifocal distraction-compression osteosynthesis after segmental resection of the articular end of the bone.

**Technical errors** in the process of osteosynthesis were "cutting" of the traction-guiding olive wires out of the displaced fragments in 12 patients (9.0 %). Wires that were tensioned weakly broke in 4 patients (3.0 %). Incomplete osteotomy (corticotomy) was detected in 3 patients (2.3 %).

We encountered treatment-related complications in 24 patients (18.0 %). It was inflammation of the soft tissues in the area of wire introduction or postoperative wounds, vascular disorders, neuritis of the peroneal nerve, development or aggravation of the contracture of the hip, knee or ankle joints. The most frequent complications were inflammation in soft tissues (15.2 %) and hip, knee and ankle joint contractures (10.7 %), in relation to the total number of treated. One vascular complication (0.7 %) was bleeding at the point of wire exit from the soft tissues during the fixation period. The bleeding ceased after wire removal and application of a pressure bandage of a hammock-like type. Swelling of the soft tissues of the femur and lower leg with the development of chronic ischemia of the distal limb part was observed in 7 patients (5.4 %) in different periods, which was due to the traumatic nature of the operative intervention and, as a consequence, changes in lympho- and venous outflow and trophic changes. In 90.2 % of the patients who developed complications, all of them were eliminated in the course of the osteosynthesis applied.

## DISCUSSION

Analysis of errors and complications arising in the course of treatment of patients with neoplasms of lower limb long bones with the use of external fixation should assist the surgeons who show practical interest in this technique though the attitude of orthopaedic surgeons and oncologists to it is ambiguous. Investigating errors

and complications, we find the causes and mechanisms of their occurrence. Treatment outcomes can be improved by their timely detection and elimination. By managing their mechanisms, the negative effect of errors can be reduced to a minimum.

It should be emphasized that these errors were not

accompanied by significant anatomical and functional disorders. The overwhelming majority of them can be corrected by conservative measures and do not lead to the necessity of osteosynthesis cessation. However, the resulting medical complications can significantly prolong the period of hospitalization and impair the quality of rehabilitation. All the errors and related complications were caused by violation

of organizational measures in 27.0 % (36 patients), in 8.3 % (11 patients) due to non-compliance with tactical principles and in 12.8 % (17 patients) as a result of technical errors in implementation of transosseous osteosynthesis. Medical complications were most numerous (18.0 %, 24 patients). Those are soft tissue inflammation and secondary contractures of large joints.

#### CONCLUSION

Systematization of errors and associated complications allowed us to develop recommendations for their prevention and treatment. These are a complex of therapeutic and prophylactic measures that prevent

possible difficulties in the treatment course, provide a more effective and qualitative rehabilitation of patients with long bone tumour pathology, and reduce their inpatient stay.

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