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MISTAKES AND COMPLICATIONS IN THE TREATMENT OF PATIENTS WITH DISTAL HUMERUS FRACTURES

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Abstract

Risks of complications in the treatment of humerus distal fractures are rather high. This gives rise to a lot of controversy and, as a result, the need for research and development aimed at preventing errors and complications. **Purpose:** to study the structure of errors and complications being arisen in the treatment of patients with distal fractures of the humerus, and outline ways to eliminate them. **Material and methods:** A retrospective analysis of treatment outcomes was performed in 72 patients (52 men and 20 women, mean age 39.7 years) with distal humerus fractures. During treatment with the use of external osteosynthesis the errors and complications were identified in 43 patients (group I), 29 patients (group II) had error and complications after transosseous osteosynthesis. **Results:** Analysis of adverse treatment outcomes showed that in group I, diagnostic errors amounted to 2.3%, tactical errors - 11.6%, technical errors - 20.4%. In group II, only technical errors were noted and they accounts for 10.8%. Surgical treatment errors of this localization injuries led to the development of 23.3% of failures with external osteosynthesis, and 13.8% with transosseous osteosynthesis. **Conclusions:** a surgeon's qualification is the most important factor in distal humerus fractures patients treatment. This should include experience, application of optimal treatment tactics in each specific case, and anticipation of various complications development.

Key words: distal humerus fracture; lower third; complication

Introduction. In the structure of skeletal bone fractures, extra-articular injuries of the low-third humerus diaphysis (LTHD) account for about 30% and are a problem of modern traumatology and orthopedics [1]. The relevance of functional recovery after these fractures depends on the severity of the damage and the effectiveness of the treatment methods used, since unsatisfactory results of treatment reach 62% [11]. Such a high percentage of adverse outcomes is due to the development of complications because mistakes made in some cases for various reasons in the treatment of this category of patients. The proposed methods of closed reposition do not justify themselves and have limited indications for their use, while open surgical interventions are quite traumatic and are associated with the risk of infection [3, 4, 6, 9].

The risk of complications is high while the complexity of providing surgical care in case of a LTHD injury gives rise to a lot of contradictions and, as a result, the need for research and development of the techniques aimed at preventing errors and complications.

Purpose: to study the structure of errors and complications that arose in the treatment of LTHD patients and to outline ways of their elimination.

Material and methods. The adverse treatment outcomes in extra-articular LTHD injuries were the criterion for inclusion in the retrospective study. The exclusion criteria were intra-articular fractures of LTHD, the absence of information about the presence of complications, all cases of fractures without displacement, combined with injuries of another localization, or refusal to participate in the study. All errors and complications that arose during surgical treatment and affected the long-term results of treatment (up to 3 years) from the moment of injury were identified. The quality of the diagnostic and therapeutic measures performed (on-bone and transosseous osteosynthesis) was assessed by conducting a questionnaire, control personal examinations, telephone interviews and case histories, paying special attention to the observance of therapeutic and tactical principles - the phasing and sequence of all therapeutic measures.

The material for the analytical study was the official data of the primary documentation of 72 LTHD fractures patients, aged 21 -o 70 y. o. (mean age 39.7 years). The patients under study were treated in 2015 - 2019, there were 52 (72.2%) male patients, and 20 (27.8%) female ones.

The patients were divided into two groups depending on the type of surgical interventions: the first group (comparison) included 43 (59.7%) persons who underwent open

reposition and internal fixation (ORIF) with plates of different manufacturers; the second group (research) consisted of 29 (40.3%) patients who underwent transosseous osteosynthesis (TOO) with an external fixation with device of our design [7].

The study was approved by the Odessa National Medical University Bioethics Commission (protocol No. 124 from 02.02.2017) and carried out in accordance with the principles of the WMA Declaration of Helsinki.

All patients signed informed consent to participate in the study, conducted standard general clinical studies, verified PD in accordance with the regulatory documents of Ukrainian requirements.

Analysis of the statistical data obtained showed that type 12A fractures (helical, oblique and transverse) in absolute numbers and percentages occupied the leading position and amounted to 40 cases (55.6%), followed by comminuted fractures (type 12B) - 23 (31.9%), then multi-comminuted (type 12C) fractures - 9 (12.5%).

All patients under examination had unilateral injuries of the upper limb, among which the left shoulder was most often injured (55.6%). Open fractures of LTHD (I – II degree of severity according to Gustilo R. B., Anderson J. T., 1976) occurred in 4 (5.6%) patients. Radial nerve neuropathy was registered in 6 (8.3%) cases.

Results and its discussion. The study and analysis of long-term results of treatment allowed us not only to evaluate the methods used, but also to determine the causes of adverse effects, as well as to identify complications and reveal errors made.

A prospective analysis of the study group treatment results showed that unsatisfactory results were due only to technical errors (10.8%) during the performance of PCOS. The most typical were inaccurate insertion of the rods at the first stages of mastering the device developed. This affected the duration of the operation due to the need to rehandle the rods. The quality of reposition was also reduced by non-compliance with the details of the operation technique and the limitation of some technical capabilities of the device itself. Technical errors also included non-compliance with the rules of postoperative management of patients; patients' ignoring the doctor's prescriptions as to device care; violation of rehabilitation measures; rules of asepsis and antisepsis in the outpatient setting.

In comparison group patients diagnostic errors amounted to 2.3%, tactical errors to 11.6%, technical errors to 20.4% (see the Table below).

Postoperative complications were observed in both clinical groups, but their frequency is higher in the comparison group. So, it can be stated with probability ($p = 0.07$) that the indicators obtained differed significantly and depended on osteosynthesis type.

Structure of complications in clinical groups humerus distal fractures patients after surgery

Complications	ORIF (n = 10)	PCO (n = 4)
Nonunion of humerus	3	1
Nonunion of the elbow's tip	1	Nonun
Superficial infection	2	3
Instability	1	
Heterotopic ossification	4	
Radial nerve neuropathy	6	
Elbow contracture	5	
Total	22	4

Thus, 10 (23.3%) out of 43 patients of comparison group had 22 complications of different origin. Neuropathy had the greatest clinical significance (n = 6). In our opinion, this complication was associated with the exposure of the radial nerve during surgery. It was a result of primary injury only in 2 persons. After conservative therapy the nerve function recovered in 4-5 months. If the treatment was ineffective, a second operation was performed with neurolysis during the removal of the fixators, and this ensured the restoration of nerve's function in 2–3 months.

Multi-comminuted fractures and errors in the surgical technique (inadequate choice of fixator) resulted in fracture nonunion in 3 cases and plate destruction in one case after ORIF.

Based on the results obtained, it follows that contractures for up to one year (n= 3) and in the long-term period (n = 2) directly limited the functional activity of patients. According to Morrey B.F. [11] classification they distinguish an external type of contractures caused by extra-articular reasons associated with the joint capsule, collateral ligament, myogenic component, and heterotopic ossification (n= 4). The use of ORIF led to late motor activity in the elbow joint because of traumatic character of operation itself and lack of an effective rehabilitation under outpatient conditions. The cases of flexion contracture prevailed (52.4%), which was facilitated by the non-physiological angle of the elbow joint fixation. We believe that an excessive period of external plaster immobilization is unacceptable for these injuries, but only necessary.

Among the early complications (n = 2) there were soft tissues inflammations which, after corresponding measures were stopped and did not affect the results of treatment. Deep infections were not observed.

In the study group, 4 (13.8%) out of 29 patients had the four types of complications.

Early complications (superficial inflammation of the soft tissues around the rod) prevailed (n = 3) but did not require premature dismantling of the device. The complications mentioned were stopped by therapeutic measures and did not significantly affect the result. The presence of signs of delayed union (n =1) was the reason for the stimulation of the fragment's consolidation according to G. A. Ilizarov method (1952). Union was achieved in 5 months.

In general, among the patients under examination post ORIF complications (23.3%) exceeded by 1.7 times the percentage of complications in PCO group (13.8%). But the compliance with all the detailed requirements for the technology, both internal and external osteosynthesis, the percentage of errors and complications can be avoided or minimized significantly.

Summarizing modern scientific publications, it can be noted that experts do not have a unanimous opinion regarding the choice of the optimal method of surgical treatment of LTHD fractures [1, 5]. The main indications that determine the choice of treatment tactics are the degree of displacement of fragments and shoulder soft tissues (edema, phlyctenae, wounds) conditions. The most popular methods of bone fragments fixation have their advantages and disadvantages, which is also confirmed by our observations, where the differences are determined only by the nature and types of complications.

The analysis of the results obtained does not allow us to establish one of the two considered types of osteosynthesis as a priority for the treatment of patients with LTHD fractures. ORIF allows maximum restoration of humerus anatomy, since visualization of the fracture site provides the best technical results of reposition. However, the proportion of instability found in a retrospective study and, as a result, non-union of bone fragments and cases of plate destruction are due to the type of fractures and technical shortcomings of fixation. Also, among the complications in the comparison group patients neuropathy, heterotopic ossification and contractures of the elbow joint are rather typical. Many of comparison indicators are quite consistent with the results of surgical treatment of LTHD fractures and are presented in numerous scientific publications [2, 4, 8, 9].

Recently, the trend of sparing treatment of soft tissues is ahead of other requirements for the treatment of LTHD fractures, namely, long-term stable fixation of fragments and early restoration of the elbow joint function [6]. Now, rod-based PCO fully meets all these requirements, since it allows stable fixation of fragments and ensures early restoration of the damaged elbow joint function. PCO clinical testing showed a dynamics presence, that

compared with ORIF, exceeds the results of restoring the function of the injured upper limb. This is especially true in cases where the use of minimally invasive osteosynthesis with an external fixation device is necessary in the presence of local or general contraindications to ORIF. In reverse order, the use of ORIF in such clinical situations can provoke the development of complications of various severity.

In conclusion, it should be emphasized that, based on the assessment of the anatomical and functional results of LTHD fractures treatment in both clinical groups, the advantage of minimally invasive osteosynthesis technique with the use of a rod device has been proven. However, when analyzing the treatment results a number of technical shortcomings of the device developed were identified, which must be eliminated by improving, first of all, the replicating support of the design. Despite this, a comparative analysis of the treatment results showed sufficient effectiveness and safety of PCO practical introduction, which reduces the complications by 1.7 times and frequency of unsatisfactory results by 5.5 times than in the comparison group after ORIF ($p < 0.001$).

The analysis of errors and complications in the treatment of LTHD fractures determined the following ways of their elimination: timely diagnosis, adequate treatment method of primary fractures; atraumatic reposition and stable fixation of fragments in the first hours or days after injury; proper postoperative management of patients; early and comprehensive rehabilitation.

Conclusions. It is necessary to continue further improvement of external devices and technique of minimally invasive osteosynthesis in order to improve the anatomical and functional results of LTHD fractures treatment.

The doctor's qualification which includes experience, acceptance of optimal treatment tactics in each specific case, and anticipation of the complications development is the most important factor in the treatment of such patients.

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