TREATMENT OF INTRA-ARTICULAR FRACTURES OF THE DISTAL HUMERUS

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Treatment of intraarticular fractures of the distal end of humerus. Radiographs of 27 patients with intraarticular humerus fractures aged 21 to 60 years (median - 37 years old) were analyzed, 17 of them were men and 10 women: they had remoteness of the fracture zone from the proximal metaphysis of the humerus, the length of the fracture zone and size displacements of fragments. In the statistical analysis of the actual data the mean, standard deviation was calculated. An analysis of the sample, including comminuted intraarticular fractures of the humerus, showed that the fracture level was in the range of 40.9±19.9%, ranging from 11.6% to 72.4% in length. Between the length of the fracture and the period of consolidation, there was a statistically significant positive moderate link. The term of fusion of the fracture of the distal end of the humerus correlates with the following characteristics: 1) the location of the fracture: the closer location of the fracture to the distal end of the humerus, the shorter fusion period; 2) the length of the fracture zone: the greater length of the fracture zone, the longer the fusion period; 3) the post-repositional value of the displacement of the fragments: the larger value of the post-repositional displacement of the fragments, the longer term of fusion. The revealed dependences are valid for fractures of the humerus in the range from 11 to 72% of the distance of the fracture from the proximal end of the humerus.

Key words: intraarticular fractures of the humerus, Ilizarov method, term of fracture consolidation.

Intra-articular fractures of the distal humerus are severe elbow joint injuries that occur in 0.5-2% of patients with bone fractures, and among all intra-articular fractures, bone fractures in the elbow joint area account for 19% [3,5,7]. Making up a small proportion of victims, these patients require special attention. This is due to both the high work activity of patients (most of them are of working age) and the significant number of unsatisfactory treatment outcomes (8.3-67%) [1,4,9], associated with the

characteristics of this segment of the upper limb: complex anatomical structure and biomechanics, participation in the functioning of three joints, high tissue reactivity. Observations show that with loss of function in the shoulder or wrist joint, patients are able to take care of themselves, and loss of function in the elbow joint leads to disability [2,5,8]. Therefore, during treatment, it is necessary to use the slightest opportunity to preserve the function of the elbow joint. The technologies of bone osteosynthesis using plates and screws, developed by the Association for the Study of Osteosynthesis (AO), have received well-deserved recognition and popularity throughout the world in recent decades [9,12,13]. These methods are constantly in the dynamics of development, the main trend of which is to reduce the trauma of surgical intervention and the negative impact of the implant on the regenerative capabilities of damaged bone tissue. This is the main focus of the new strategic concept for the development of the AO system as a whole, according to which the ideas of using limited-contact bone plates, angularly stable screws, and subfascial bridge osteosynthesis technologies have been implemented [1,5,8,14]. In combination with low-traumatic surgical techniques (the use of rational surgical approaches, special instruments, and intraoperative monitoring using an electron-optical converter), this allows for a significant reduction in the need for devitalization of bone fragments, but, of course, does not solve the problem in principle: a technologically traumatic operation cannot be performed atraumatically.

Considering the aforementioned trends in the development of bone osteosynthesis somewhat abstractly, it is easy to come to the conclusion that in its current form it actually represents an immersion extrafocal unilateral osteosynthesis. Using the example of surgical treatment of humerus fractures, we propose to consider what the actual results of the contradictions between the trauma of surgical intervention and the requirements of biological fixation are [3,6,10,11]. In our opinion, the humeral segment is the most convenient and adequate for this, since humeral fractures of all localizations may have indications for external osteosynthesis. The humeral segment is not characterized by negative features of blood circulation (in contrast to the proximal femur, distal tibia), which affect the treatment tactics; in the absence of body weight load, it is easier to perform the recommended functional regimen. The purpose of the study: to clarify scientific data on the priority of biological fixation requirements when differentiating indications for the use of humerus fracture treatment methods.

Using clinical examples of surgical treatment of humerus fractures, to highlight the problems associated with bone tissue devitalization during osteosynthesis, with subsequent analysis of the features of surgical technologies that meet the requirements of biological fixation.

Material and methods

A total of 27 patients with intra-articular fractures of the distal humerus were treated in the clinic from 2023 to 2024. We approached the choice of treatment tactics

individually in each case: the severity of concomitant injuries and intercurrent pathology, vital activity of patients, profession, duration of injury, nature of the traumatic factor, severity of damage to soft tissues in the elbow joint area were taken into account. Analysis of the injury mechanism allows us to conclude that exposure to a moderate traumatic factor is sufficient for an intra-articular fracture of the distal humerus to occur. Most patients (18 people) were injured as a result of falling from their own height, 4 patients - in road accidents, 2 - while playing amateur sports, 3 - at work. Most patients (84%) had closed fractures, and 16% had wounds of various nature and size in the fracture area, which indicated infection of the fracture and a high risk of postoperative infectious complications.

The open nature of the fracture served as a direct indication for primary surgical treatment of the wound and osteosynthesis of the humerus fracture on an urgent basis, however, in some cases, the timing of surgical treatment was postponed until the wounds healed. In our work, we used the AO classification, which allows choosing the optimal treatment tactics for different types of injuries to the distal humerus. The analysis of our clinical observations allowed us to distinguish several groups of intra-articular fractures of the distal humerus in accordance with the accepted medical and economic standards: fractures without displacement; supracondylar fractures (8 patients - 10.4%) - A2-A3 according to the AO classification (the articular surface of the humeral condyle is not damaged, but the fracture line runs along the lower edge of the cubital fossa, that is, distal to the attachment of the joint capsule, and the fracture is classified as intra-articular); unilateral condyle fractures (3 patients - 10.4%) - B1, B2 according to the AO classification; supracondylar multi-comminuted fractures of the humeral condyle (7 patients – 68.8%) – C1, C2.1, C3.1 according to the AO classification; fractures of the condyle and columns of the humerus (5 patients – 5.2%) – C2.2, C2.3, C3.3 according to the AO classification; vertical fractures of the capitate eminence and trochlea of the humerus (4 patients – 5.2%) – B3 according to the AO classification.

When choosing the treatment tactics for patients with suspected humeral fracture, the presence of concomitant injuries was taken into account. Particular attention was paid to the presence of neurological symptoms and vascular disorders in the distal parts of the upper limb before and after the manipulations. Depending on the type of fracture, severity and direction of displacement of bone fragments against the background of increasing edema of soft tissues, damage to the ulnar, radial or median nerve, as well as the brachial artery in the elbow joint area may occur.

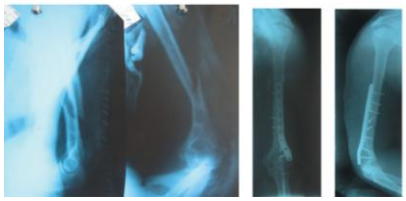

Fig.1. Patient D.V. 45 years old

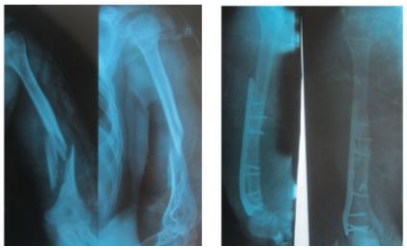

Fig.2. Patient A.L. 52 years old

During the X-ray examination of the elbow joint, we used classic positions and projections (direct and lateral projections). These methods do not always provide complete information in case of fractures of the head and block of the humerus, which is due to the peculiarities of the X-ray picture of the elbow joint. As an auxiliary diagnostic method, we used computed tomography (CT) of the elbow joint, which allowed us to assess the exact position of bone fragments, the size of bone fragments, the presence of bone tissue defects, which cannot always be determined using standard radiographs.

When conducting preoperative planning, CT data of the elbow joint help to correctly select the tactics and scope of surgical treatment. Three-dimensional CT reconstruction of the elbow joint allows you to get a volumetric representation of all components of the joint.

Results and discussion

Patients with isolated fractures of the distal humerus without displacement are recommended to stay in hospital. Treatment tactics. On admission, the patients were given a posterior splint plaster lining bandage from the metacarpophalangeal joints to the upper third of the shoulder. Plaster immobilization was used to create rest for the limb, non-steroidal analgesics were prescribed, the limb was given an elevated position, local cooling was performed to reduce swelling and prevent compression of soft tissues.

Taking into account the clinical picture, on the 7-8th day after the injury, plaster immobilization was stopped, control radiographs were taken. The elbow joint was fixed with a removable orthotic bandage with hinged limiters of the range of motion, rotational movements of the forearm began. On the 14th day, movements in the elbow joint were allowed. Immobilization continued for up to 6 weeks, control radiographs were taken. In intra-articular fractures of the distal humerus with displacement, under local anesthesia, the gross displacement of bone fragments is eliminated and the elbow joint is immobilized with a posterior plaster splint padding bandage from the upper third of the shoulder to the metacarpophalangeal joints at an angle of 90°.

Treatment of intra-articular fractures of the shoulder with angular stability of the AO. The indication for surgical treatment of fractures of the distal humerus is the displacement of fragments. Preoperative preparation of patients, as a rule, began from

the moment of admission to the hospital. It included temporary immobilization of the fracture, examination of the patient, preparation of the skin in the area of the proposed surgical intervention (daily skin toilet).

Fig 3. Patient O.F 51 years old

Fig 4. Patient S.S 42 years old

When choosing the surgical approach in patients with intra-articular fractures of the distal humerus, we were guided by the following: the approach should ensure complete visualization of the elbow joint, create conditions for manipulations in the joint cavity, on both parts of the condyle with its articular surfaces, as well as both columns of the humerus, regardless of the type of damage to the distal humerus, and also be safe with respect to neurovascular formations. These requirements are met by the posterior median approach to the elbow joint with osteotomy of the olecranon process and mobilization of the ulnar nerve. During the operation, the joint was revised, small freely lying bone fragments were removed, and the hematoma was evacuated. We believe it is necessary to use an antiseptic film and active drainage of the postoperative wound for 24-48 hours.

For fixation of fractures of the distal humerus we used Kirschner wires, 3.5 mm AO screws, reconstructive plates and the Ilizarov apparatus. Treatment of supracondylar fractures. We perform closed reposition for this type of fractures in patients with severe concomitant pathology. It is possible due to the fact that there is no damage to the cartilaginous surface of the humeral condyle and it is necessary to restore only the angular relationships of this zone. Closed manual reposition was performed under the control of an electron-optical converter (EOC) and the fragments were fixed with 4 wires inserted crosswise through the internal epicondyle at an angle of 15° to the longitudinal axis of the humerus and the external epicondyle at an angle of 30°. The ends of the wires were left above the skin. After the operation, an orthotic bandage with hinged limiters of the range of motion in the elbow joint was applied and the elbow joint was fixed in a flexion position of 90°. After 2 weeks, the results of the procedure were as follows:

After the operation, “swinging” movements in the joint with an amplitude of 10° were started. The pins were removed after 3 weeks and functional treatment was

continued under conditions of immobilization with an orthotic bandage, which lasted up to 6 weeks from the moment of osteosynthesis.

Treatment results

We consider the observation period from 6 months to 1 year to be sufficient to evaluate the treatment results, by which time the patients fully recover their ability to work. The results were studied in all operated patients and divided into three groups: • good – range of motion in the elbow joint> 100°, no pain or neurological symptoms, the patient returned to his previous work, full self-care; • satisfactory – range of motion 70°-99°, pain during exertion, transient paresthesia, the patient switched to lighter work, full self-care; • unsatisfactory – range of motion <70°, pain during movements in the elbow joint, persistent neurological symptoms, the patient was assigned a disability group, the function of the upper limb does not ensure full self-care. One year after the surgical treatment, good results were determined in 78.5% of patients, satisfactory – in 13.7%, unsatisfactory – in 7.8%.

All errors were divided into three groups: diagnostic, tactical and technical. Diagnostic errors were understood as incorrect understanding of the fracture nature (2 patients with vertical fractures of the head and block of the humerus), the treatment tactics were changed after the patient underwent CT of the elbow joint. Tactical errors included the wrong choice of osteosynthesis method without taking into account the fracture nature (2 patients). Technical errors included errors made during osteosynthesis of intra-articular fractures of the distal humerus. Such errors occurred in 2 patients, which led to significant limitation of motion in the elbow joint. Complications in the treatment of intra-articular fractures of the distal humerus were divided into 4 groups.

Postoperative wound suppuration is one of the most formidable complications that can nullify all previous efforts. Careful preparation of the skin, the use of antibacterial drugs, careful hemostasis, active drainage of the postoperative wound and careful attention to the details of the surgical intervention when separating the skin and separating soft tissues should make the risk of infectious complications with this type of upper limb injury no higher than with any other open reposition. After skin treatment in the operating room, an antiseptic surgical film was used without fail.

The complication occurred in 1 patient (1.9%). Fatigue fracture, migration of metal fixators is a complication that develops in the presence of micromobility of fragments in the fracture zone as a result of unstable osteosynthesis, if the patient does not follow the recommendations of the attending physician. Preoperative planning, careful selection of metal fixators manufactured using modern technologies, strict adherence to osteosynthesis techniques, and patient compliance with the attending physician's recommendations help to avoid this complication.

This complication occurred in 2 patients (3.8%). Ulnar nerve neuropathy can develop both as a result of the injury itself and as a result of surgical intervention, which requires mobilization of the ulnar nerve during surgical access to the elbow joint. The complication developed in 2 patients (3.8%).

We believe that one of the causes of heterotopic ossification is unstable fixation of fragments, which causes micromobility in the fracture zone, which is a consequence of improper preoperative planning. Patients suffering from deforming osteoarthrosis are at risk. This complication occurred in 3 patients (5.7%) and led to the development of elbow joint contracture.

Conclusion

An analysis of the treatment of intra-articular fractures of the distal humerus shows that one should always remember the fragile balance that exists between the ideal reposition of bone fragments and the creation of a stable "fixator-segment" system and the severity of the surgical injury. In case of a violation of this balance, delayed fusion or lack of fusion leads to the destruction of the fixators. Without belittling the great achievements of AO, attention should be paid to the differentiation of indications for the choice of fracture treatment methods, focusing not only on the possibility of anatomical reposition and fixation, but, first of all, on the compliance of the chosen method with the requirements of biological osteosynthesis.

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