MINIMALLY INVASIVE METHODS OF SURGICAL TREATMENT FOR INJURIES OF THE UPPER EXTREMITIES IN CHILDREN

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INTRODUCTION	Upper extremity fractures figures up to 84 % of all extremity fractures in children.
MATERIAL AND METHODS	In 2004–2013, 504 operations were performed in children aged 5 to 17 years for various injuries of the upper extremity using image intensifiers in Minsk Clinical Centre of Trauma and Orthopaedics of 6th Minsk Clinical Hospital (Children's Department)
RESULTS	Immediate results were good or excellent in 98.8 % of patients. In 1.2 % of patients, post-traumatic transient neuropathy of the radial and median nerves was observed.
CONCLUSIONS	Minimally invasive operations with image intensifiers performed to treat injuries of the upper extremity in children are highly effective and allow open reduction and skeletal traction to be avoided.

Keywords: Upper extremity, fracture, osteosynthesis, image intensifiers, reposition.

INTRODUCTION

In children, damage to the bones of the shoulder girdle and upper limbs are much more common than fractures and dislocations of the lower limbs. These injuries are very diverse and complex in the diagnostic, therapeutic and prognostic tactical sense [1–6].

Anatomical and physiological age-related features of the musculoskeletal system of children and the prevailing types of injury inherent in every age, determine incidence, location and nature of injuries common in a particular child's age-group [1, 3, 5–7].

Damage to the humerus in children occurs in 25% of cases [1, 2, 4, 7, 8]. Fractures of the distal epimetaphysis of the humerus occur most often, second are fractures of the proximal humerus, and diaphyseal fractures occur rarely [1, 3, 4, 7, 8].

Fractures and dislocations of the forearm bones are mostly occurring among fractures of the other segments of the upper extremity (63.5 – 69.6%), as well as among injuries of other sites of the musculoskeletal system (32–44%) [1, 2, 5, 9].

The guiding principle of the treatment for fractures of the upper limb in children is a conservative method (90–98%) [1–5]. In most cases, the fixing bandage is applied. Immobilization is generally carried out in the mid-physiological position covering 2/3 of the limb circumference and fixing two adjacent joints. Cylinder plaster bandage is not applied in children with recent fractures, as there is a risk of circulatory disorders due to progressive edema (Volkmann's ischaemic contracture) [1, 2, 4, 6–8].

Indications for surgery in children with fractures are: 1) intra- and periarticular fractures with displacement and rotation of a bone fragment; 2) two-attempt closed reduction, if the remaining displacement is classified as unacceptable; 3) interposition of soft tissue between the fragments; 4) open fractures with significant soft tissue injury [1–3, 5, 7–9].

MATERIAL AND METHODS

During the period from 2004 to 2013, 504 operations with the use of emission-optical converter (EOC) were performed in children aged 5 to 17 years for various injuries of the upper extremity in Minsk Clinical Centre of Trauma and Orthopaedics of 6th Minsk Clinical Hospital (Children's Department): transcondylar humeral fractures

– 132 operations (26.2%), surgical neck and diaphyseal fractures of humerus – 47 (9.3%), fractures of the forearm bones – 201 (39.9%) (including 17 (8.5%) fractures of the neck of the radius), hand fractures – 91 (18.6%) and multiple injuries – 33 (6.5%).

Surgical treatment was performed immediately on admission of patients to the hospital or within the first 3 days. Average duration of the hospital stay was 4 days.

In patients with transcondylar humeral fractures, closed reduction under visual control on the screen of the image intensifier and fixation of fragments with two or three Kirschner wires followed by immobilization of the limb by the plaster cast were performed. Stability of fixation of fragments was verified by passive movement in the elbow joint under X-ray control.

In fractures of the surgical neck of the humerus, bone fragments were fixed with Ilizarov or Kirschner wires, inserted intramedullary in the following ways: through the lateral epicondyle of the humerus, through the acromial process and the diaphysis of the humerus using diafixation method.

In fractures of the diaphysis of the humerus, fragments were fixed with Ilizarov wires, inserted intramedullary through the lateral epicondyle of the humerus.

In fractures of the forearm bones, fragments were fixed intramedullary with wires inserted through the olecranon and distal metaepiphysis of the radius.

In multiple injuries of the upper extremity (Monteggia, Galeazzi fracture-dislocations, fractures of several segments of one limb), all kinds of displacement were eliminated and all the damaged segments were fixed with Kirschner or Ilizarov wires simultaneously.

After all minimally invasive operations, additional fixation was carried out applying plaster cast. The average duration of surgery using the image intensifier was 10–20 minutes, depending on the type of damage. Patients were discharged home for outpatient treatment 2–5 days after surgery.

Indications for surgical intervention under the monitoring of the image intensifier were:

1) unsuccessful closed reduction;
2) multiple injuries of several segments of one limb;
3) significant displacement of fragments.

Clinical example No. 1

Patient D. with an injury resulting from a fall down onto an outstretched right hand. As a result, the patient had the closed comminuted proximal osteoepiphysiolisis of the right humerus with displacement of fragments (Fig. 1). Patient underwent closed reduction and transacromial fixation with wires under image intensifier monitoring (Fig. 2).

Clinical example No. 2

Patient G. with trauma resulting from a fall from a bike onto an outstretched left hand. As a result, there was a closed transcondylar extension fracture of the left humerus with displacement of fragments (Fig. 3 and 4). In the operating room, the patient underwent closed reduction and transosseous osteosynthesis with wires under image intensifier monitoring (see Fig. 5 and 6).

Clinical example No. 3

Patient L. with an injury from a fall from the swings onto an outstretched left hand. The result was a closed transcondylar extension fracture of the left humerus with displacement of bone fragments and the closed distal osteoepiphysiolisis of the radius with displacement of fragments (Fig. 7 and 8).

In the operating room, the patient underwent closed reduction and fixation of the left humerus and radius bones with wires under image intensifier monitoring (Fig. 9).

RESULTS

Immediate results were good or excellent in 98.8 % of patients. In 1.2 % of patients, post-traumatic transient neuropathy of the radial and median nerves was observed.

CONCLUSION

Minimally invasive surgery with the image intensifier in children with the upper extremity injuries is a highly effective method of treatment, and in most cases, allow open reduction and skeletal traction to be avoided, reducing the terms of treatment, rehabilitation, and duration of hospital stay.

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