GEORGIAN MEDICAL NEWS


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აღნიშნული ჰექის განვითარების შემდგომ პროცესში ჰექის.
OSTEOSYNTHESIS OF COMPLEX COMMINUTED HAND BONE FRACTURES BY APPLYING THE LACING METHOD (A CLINICAL CASE STUDY)

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Abstract.

Introduction: Complex comminuted hand injuries are an urgent medical and social problem of national health systems, which is especially sensitive for countries with a low level of socio-economic development.

Aim: The work aims to substantiate the effectiveness and safety of the shoelace method of hand bone osteosynthesis in complex comminuted fractures (a clinical case study).

Clinical case: A 42-year-old female patient was admitted to the clinic with complaints of the presence of a crushed wound on the 2nd finger of the left hand. The shoelace method was applied for hand bone osteosynthesis. The surgical intervention time was 24 minutes, and the time before returning to work or daily activities equaled 7.1 weeks. The time to bone fusion was less than 45 days. Conclusions: The shoelace osteosynthesis method in complex comminuted fractures of the hand bones has prospects for modern clinical practice with the possibility of improving the performance and safety indicators.

Key words. Clinical case, complex comminuted hand fractures, patented invention, shoelace osteosynthesis method, clinical performance.

Introduction.

Complex comminuted hand injuries (for example, fractures of the phalangeal bones of the fingers) are an urgent medical and social problem of national health systems [1-5], which is especially sensitive for countries with a low level of socio-economic development [6].

More than 50% of traumatic injuries in the world occur in low- and middle-income countries [6]. A systematic review of the Global Burden of Diseases, Injuries, and Risk Factors Study GBDIRFS 2017 [7] showed that in low- and middle-income countries, hand injury rates were steadily increasing by as much as 25%. Hand injuries represent a significant economic burden, accompanied by high costs associated with health care and labor productivity [8,9]. As a result of hand injuries, the economically able-bodied segment of the population suffers. This segment is the main unit of labor productivity with an average peak age of 39.4 years [10]. A systematic review and meta-analysis by O'Hara et al. [11] showed that after 12 months of follow-up, 40.5% of patients did not return to their previous work (95% CI: 8.4–83.4); of those who returned, absence from work equaled 102.3 days (95% CI: 94.8–109.8); and the average loss of earnings was $14,621. Although most phalnx fractures can be treated non-operatively with appropriate immobilization, complex finger fractures often require timely diagnosis and surgical treatment [12].

Meara et al. [13] state that, according to the forecast, by 2030, low-income countries will not have adequate access to appropriate diagnostic equipment and qualified surgical personnel [17], which will expose the population to a greater risk of long-term consequences of upper limb injuries. Continuing the line of relevance of timely diagnosis and surgical treatment for complex finger fractures, there is no consensus in the global theory and practice of diagnosis and treatment of complex fractured hand injuries [14, 15]. Therefore, there is a need to review the current state of global diagnostics and surgical treatment for complex finger fractures to optimize existing national algorithms, especially in low-income countries.

Purpose of the study was to demonstrate the effectiveness and safety of the shoelace method of hand bone osteosynthesis in complex comminuted fractures using a clinical case study.

Materials and Methods.

Female, aged 42, was admitted to the clinic with the following complaints: the presence of a crushed wound on the 2nd finger of the left hand, bleeding from the wound, pain in the wound, and acute dysfunction of the left hand. Case history: according to the patient, she was injured at work in a restaurant. Her hand got into the meat grinder. She was admitted to the hand microsurgery department of the National Hospital under the Ministry of Health of the Kyrgyz Republic (NGMZKR).

Diagnosis: incomplete traumatic amputation of the 2nd left-hand finger at the level of the main phalanx with comminuted bones of the main phalanx, middle phalanx, and the proximal interphalangeal (PIP) joint. Bleeding. Compensated blood circulation (Figures 1-8).

Figure 1. Incomplete traumatic amputation of the 2nd left-hand finger with comminuted articular head of the main phalanx.
Figure 2. Incomplete traumatic amputation of the 2nd left-hand finger with comminuted articular head of the main phalanx.

Figure 3. X-ray of the left hand upon admission.

Figure 4. Holes made with an injection needle.

Figure 5. Kirschner needles.

Figure 6. Restoration of the articular head of the main phalanx by the shoelace method.

Figure 7. The view after the surgery.

Figure 8. X-ray images 30 days after surgery.
We performed osteosynthesis of the 2nd middle and main phalanges by the shoelace method with fixation with a Kirschner wire.

The shoelace hand bone osteosynthesis method is carried out as follows. The comminuted fragments of the phalanx are repositioned and put into the correct places. Next, 2 transverse through holes are made on each fragment, the fragments are adapted, and transosseous osteosynthesis is performed with a polypropylene thread 4.0 with a needle thread passing through these holes, i.e. suturing the bone fragments. Thus, the phalanx is restored.

The knot is tied at the point of entry into the first fragment and point of exit from the last fragment, like shoe laces (hence the method can be called the shoelace method). When tying the knot, the bone fragments are tightly pulled together into one, with the restoration of the former anatomical shape and function of the phalanx, coming together closely. Injection needles from a 10 ml syringe are used to make the holes. The needle is fixed to the head of the electric drill instead of the Kirschner wires.

Unlike conventional Kirschner wires, the needle allows holes to be made almost without additional injury to small bone fragments, even if it is a fragment of 0.5 cm in size. After the shoelace osteosynthesis, longitudinal trans-articular osteosynthesis of the middle and main phalanx is performed with a Kirschner wire for additional stabilization and fixation of fragments.

The articular capsule of the interphalangeal joint and tendons are restored with a polypropylene 4.0 thread on the skin. Plaster immobilization is performed on the back of the hand.

On the morning after the operation, osteosynthesis was stable, and the wound did not trouble the patient. In our patented technique, the maximum fracture forces equaled 180.2. The stiffness indicators were 30.3 N/mm.

The patient's wound healed by secondary tension, as the soft tissues of the finger had been crushed. On a control X-ray image, after 30 days, the appearance of a callus on the fracture lines was noted.

In our patented technique, the maximum fracture forces equaled 180.2. The stiffness indicators were 30.3 N/mm.

In terms of performance, the issues of the average surgical time of osteosynthesis, the average time to radiological bone fusion, compression strength, full active movement, and the average time to return to work or daily activities are of great importance.

The time to bone fusion with the application of our patented technique was less than 35 days.

The surgical time for the application of our patented technique was 24 minutes, the fluoroscopy time was 20.44 seconds, and the time before returning to work or daily activities was 7.1 weeks.

According to the results of 6 months of observations, no complications occurred in our patented technique.

In this clinical case where we applied the patented technique, there was no damage to the bones or soft tissues of the patient. There were no repeated attempts to fix the Kirschner wire.

**Discussion.**

Our clinical case study demonstrated the performance and safety of the shoelace method [18] of hand bone osteosynthesis in complex comminuted fractures (patented technique). Compared with Kirschner's wires [19] and alternative osteosynthesis options for multiple comminuted hand bones, according to the results of our clinical case, the patented invention of the shoelace method demonstrated higher performance and safety indicators. The wires used during the surgical procedure were removed earlier than with conventional methods. The recommendation for clinical practice is to apply this invention, which has high prospects for balancing out the main disadvantages of the Kirschner wire method (rotational instability of fractures, potential loss of fracture stabilization: [20]) with improved performance and safety indicators for patients with multiple comminuted hand bones. Effectiveness of the surgical method employed in this case in comparison to the existing surgical procedures is evident.

The next perspective of the results of our clinical case is the possibility of further elaboration of the shoelace method in upcoming studies, which will contribute to modern theory.

**REFERENCES**