

SURGERY

TWO-STAGE SURGICAL TREATMENT OF A PATIENT WITH FLEXION-EXTENSION CONTRACTURE OF THE ELBOW JOINT USING HYDRAULIC MOBILIZATION

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ABSTRACT

Background. Numerous surgical techniques have been proposed for the treatment of patients with persistent elbow contractures that cause significant functional impairment. However, the treatment results are not always satisfactory for surgeons and patients due to the invasive nature of the procedure and the risk of contracture recurrence.

Aim. To demonstrate the feasibility of using hydraulic mobilization for the management of the soft tissue component of contracture to improve elbow function.

Methods. During the first stage of surgical treatment, hydraulic mobilization of the elbow joint and collateral ligaments was performed to increase the angle of extension. Saline solution was used to dilate the joint cavity, stretch the capsule, and release any scarring from the ligaments. Tunneling of the proximal metadiaphysis of the ulna and distal metadiaphysis of the humerus was also performed to improve blood flow to the bone and reduce intraosseous pressure. At the second stage of treatment (6 months after the first stage of surgery), arthrotomy of the left elbow joint, osteotomy of the mal-united fragment of the humeral capitellum, its resection, and plaster immobilization of the left upper limb were performed.

Results. After the first stage of treatment, the elbow extension angle was increased to full extension. After the second stage, elbow flexion function improved. The patient's quality of life improved, and they are now able to use their arm fully. No significant pain was reported.

Conclusions. In this case, the presented treatment strategy is justified and optimal, as it adheres to the principles of gentle tissue handling during surgery, early initiation of active motion, and avoidance of passive redressing manipulations that cause pain and microtrauma to the elbow joint and accelerate mesenchymal tissue maturation. Hydraulic mobilization requires no additional surgical approaches or special equipment, causes virtually no trauma to surrounding tissues, reduces surgical time, and eliminates the risks of open surgical techniques.

Keywords: elbow joint, contracture, hydraulic mobilization, osteotomy, results

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ДВУХЭТАПНОЕ ХИРУРГИЧЕСКОЕ ЛЕЧЕНИЕ БОЛЬНОЙ СО СГИБАТЕЛЬНО-РАЗГИБАТЕЛЬНОЙ КОНТРАКТУРОЙ ЛОКТЕВОГО СУСТАВА С ПРИМЕНЕНИЕМ ГИДРАВЛИЧЕСКОЙ МОБИЛИЗАЦИИ

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РЕЗЮМЕ

Обоснование. Для лечения больных со стойкими контрактурами локтевого сустава со значительными функциональными нарушениями предложено множество хирургических методик. Однако не всегда результаты лечения устраивают хирургов и пациентов в связи с травматичностью операции и рецидивом контрактуры.

Цель. Продемонстрировать возможность применения гидравлической мобилизации на этапе устранения мягкотканного компонента контрактуры для улучшения функции локтевого сустава.

Методы. На первом этапе оперативного лечения для увеличения угла разгибания произведены гидравлическая мобилизация локтевого сустава и коллатеральных связок с применением физиологического раствора с целью дилатации полости сустава, растяжения его капсулы, освобождения связок от возможных рубцов. Также была выполнена туннелизация проксимального метадиафиза локтевой кости и дистального метадиафиза плечевой для улучшения кровообращения в кости и снижения внутрикостного давления. На втором этапе лечения (через 6 месяцев после первого этапа) произведены артротомия левого локтевого сустава, остеотомия неправильно сросшегося фрагмента головчатого возвышения плечевой кости, его резекция, гипсовая иммобилизация левой верхней конечности.

Результаты. После первого этапа лечения угол разгибания увеличен до полного. После второго этапа — сгибательная функция локтевого сустава улучшена. Повысилось качество жизни пациента, обслуживает рукой себя полностью. Болевой синдром не выражен.

Заключение. В данном случае представленная тактика лечения является оправданной и оптимальной, так как соблюдаются принципы бережного отношения к тканям во время операции, раннего начала активных движений, отказ от реддрессирующих пассивных манипуляций, вызывающих боль и микротравмы локтевого сустава, ускоряющих созревание мезенхимальной ткани. При гидравлической мобилизации не требуются дополнительных оперативных доступов, специального оборудования, практически не травмируются окружающие ткани, сокращается время операции, исключаются риски открытых оперативных методик.

Ключевые слова: локтевой сустав, контрактура, гидравлическая мобилизация, остеотомия, результаты

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BACKGROUND

According to the scientific literature, 30 % to 60 % of patients following elbow injuries require various functional reconstructive procedures for persistent contractures and associated deformities [1, 2].

The management of patients with extra-articular elbow contractures (according to the classification of B.F. Morrey, 2000 [3]), i.e., those without bony obstruction to articular surface motion, often presents considerable challenges. As reported in an analytical review of the relevant literature [1], approximately half of the patients experience a substantial reduction in the range of motion in the operated elbow joint.

A wide array of surgical interventions has been proposed for the correction of severe elbow contractures with pronounced functional impairment, including redressation under anesthesia, arthroscopic debridement, arthrotomy with capsulectomy, among others [1, 3]. The application of a hinged external fixator in open arthrolisis has also been described. However, this technique may only yield a transient increase in the flexion-extension arc [4]. In cases where the range of motion deficit persists following surgery, mini-lateral and mini-medial incisions are employed [5]. Nevertheless, the outcomes are not consistently satisfactory for either surgeons or patients, owing to the invasiveness of the procedure and the risk of contracture recurrence.

AIM

To demonstrate the feasibility of using hydraulic mobilization for the management of the soft tissue component of contracture to improve elbow joint function.

The patient provided written informed consent for the data publication for scientific purposes.

MATERIALS AND METHODS

This study presents a case of minimally invasive surgical treatment in a patient with flexion-extension contracture of the elbow joint, utilizing hydraulic mobilization to address the soft tissue component at the first stage and resection of a malunited fragment of the humeral capitellum at the second stage. In view of concomitant osteoarthritis, the patient additionally underwent tunneling of the proximal metaphysis of the ulna and the distal metaphysis of the humerus. This approach is based on studies of tissue blood supply dynamics and intraosseous pressure, as reported by various researchers [6].

A working-age patient with post-traumatic combined flexion-extension contracture of the left elbow joint (age 45, dominant left upper extremity) was admitted for surgical intervention. Due to the impaired hand function, self-care was compromised and occupational

activity was limited (range of motion deficit of 100°, corresponding to severe contracture). Pain in the left elbow joint was elicited by sudden movements, and the injury occurred one year ago as a result of a fall, causing a fracture of the humeral capitellum, which was treated conservatively by immobilizing the left upper limb using a plaster cast.

Upon admission, the elbow flexion angle was 100° and the extension was 140°. Hand function was assessed by measuring the flexion angle (starting from 0°, with 40° considered the physiological norm) and the extension angle (maximum extension corresponding to 180°). Radiographs were taken in the following projections: anteroposterior in maximum possible extension, and lateral in maximum possible flexion and extension. The radiographic findings included evidence of osteoarthritis, a malunited fracture of the capitellum of the humeral condyle with anterior displacement of the fragment, abnormal bone density consistent with a chronic injury, and bone impingement during forearm flexion. The articular surface was centered. The olecranon fossa did not show any deformities (Fig. 1). The impairment of extension was attributed to desmogenic contracture caused by capsular remodeling and possible involvement of collateral ligaments.

At the first stage of surgical treatment, to increase the extension angle, hydraulic mobilization of the left elbow joint and collateral ligaments was performed, with the aim of dilating the joint cavity, stretching the capsule, and releasing the ligaments from potential adhesions. To treat osteoarthritis, further tunneling of the proximal metaphysis of the ulna and distal metaphysis of the humerus was performed. Subsequently, a plaster cast was applied to the patient's left upper limb, in a position of maximum extension.

The procedure involved the stepwise insertion of puncture needles into the ventrolateral (radiocapitellar joint) and dorsal (olecranon fossa) aspects of the elbow joint. Through these needles, the joint cavity was filled under syringe pressure with physiological saline (until tight filling, in this case 20 mL). The arm was then flexed and extended with moderate force 15 times. The joint cavity was lavaged with 100 mL of physiological saline.

Tunneling was performed by creating horizontal, end-to-end channels in the humerus and ulna bones (4 fan-shaped canals per bone). A sharpened 1.5 mm diameter K-wire for transosseous osteosynthesis was utilized.

During the inpatient stay (10 days) and outpatient follow-up (30 days), the patient completed elbow flexion and extension exercises twice daily, both actively and passively. During sleep and after exercise sessions, the patient's arm was immobilized using an anterior plaster splint in the maximum extension.

Full elbow extension was achieved 7 days after surgery (Fig. 2).

The second stage of surgery was performed 6 months after hydraulic mobilization. CT of the left

elbow joint (Fig. 3) revealed a malunited intra-articular fracture of the capitellum of the humeral condyle with anterior and proximal displacement of a bony fragment, creating a "hood-like" configuration.

An anterolateral arthrotomy of the left elbow joint, osteotomy of the malunited fragment of the humeral capitellum, its resection, and temporary plaster

splint immobilization of the left upper limb were performed.

A 6-centimeter skin incision was made along the anterolateral aspect of the lower third of the patient's arm to perform arthrotomy on the elbow joint. The humeral condyle was exposed through blunt and sharp dissection, and the trochlea was identified



FIG. 1.

Preoperative radiographs of the left elbow joint in a 45-year-old female patient Z. with flexion-extension contracture before treatment: A – anteroposterior projection; B – lateral projection in maximum extension; C – lateral projection in maximum flexion



FIG. 2.

Postoperative radiographs of the left elbow joint in a 45-year-old female patient Z. with flexion-extension contracture, obtained 7 days after the first stage of surgery: A – anteroposterior projection; B – lateral projection in maximum extension; C – lateral projection in maximum flexion



FIG. 3.

3D CT reconstruction images of the left elbow joint in a 45-year-old female patient Z. with flexion-extension contracture, obtained before the second stage of surgical treatment: A – ventral view; B – dorsal view; C – posterolateral view; D – medial view; E – lateral view

using a periosteal elevator. Osteotomy of the mal-united fragment of the capitulum and its resection were performed with an osteotome. The flexion angle in the elbow joint was increased to 55°, while extension reached 180°. The wound cavity was

irrigated with betadine solution. The wound was closed in layers, and dressings were applied. Hemostasis was maintained throughout the procedure using electrocautery.

During the first postoperative week, the patient performed elbow joint exercises at the hospital. To prevent the formation of heterotopic ossification, the patient was administered Mydocalm® 50 mg three times daily orally for 15 days. Additionally, indomethacin was prescribed in an increasing and then decreasing dose (25 mg daily on days 1–3, 50 mg in two doses on days 4–6, and 75 mg in three doses on days 7–9), followed by a three-day tapering regimen. Microwave therapy (150 GHz terahertz electromagnetic waves) was also administered.

RESULTS

The treatment outcome was assessed as favorable. The flexion angle reached 70° (Fig. 4). Complete extension was achieved at the elbow joint.

At both short-term and long-term follow-up (one year after the second procedure), the patient's quality of life has substantially improved. The patient's ability to care for themselves has been restored, and the pain intensity has decreased markedly (from a score of 7 to 1 on the VAS scale). Additionally, the flexion-extension deficit has been reduced by half (Fig. 5).

DISCUSSION

To improve blood circulation in the tissues of the elbow joint and reduce intraosseous pressure, subchondral tunneling of the metaphyses



FIG. 4.

Postoperative radiograph of the left elbow joint showing maximum flexion in a 45-year-old female patient Z. with flexion-extension contracture, taken 7 days following the second stage of surgical treatment

of the humerus and ulna was additionally performed on this patient. The clinical efficacy of tunneling the bones comprising the elbow joint has been previously demonstrated [7].

According to the fundamental works of B.F. Morrey, a limitation of extension by 30° or more significantly compromises upper extremity function, and this limitation is even less well tolerated by patients involved in gymnastics or throwing sports. In the present case, the patient reported significant functional limitations in daily activities due to a 40° extension deficit and a 60° flexion deficit. Therapeutic success was achieved through the use of a minimally invasive hydraulic mobilization technique at the first stage, which is indicated for treating desmogenic contractures. The chosen treatment strategy was appropriate and optimal, as it followed the principles of avoiding trauma to tissues, early functional loading, and avoiding forced manipulations that can cause pain and micro-trauma to joint tissues [2]. This approach helped prevent the development of arthrofibrosis, recurrence of contractures, and progression of osteoarthritis.

In contrast to arthroscopy [8, 9], hydraulic mobilization did not require any additional surgical approaches or specialized equipment. It caused minimal trauma to surrounding tissues, reduced operative time, and eliminated the risks associated with open surgical techniques.

The results achieved after the first stage (hydraulic mobilization) were found to be long-lasting. However, some researchers have reported that, despite comprehensive postoperative rehabilitation, the range of motion may decrease by up to 25 % over time [10]. The literature on the postoperative rehabilitation of the elbow joint is still limited, and most clinical studies do not fully describe rehabilitation protocols [11].

The second stage of the surgical treatment with arthrotomy was performed 6 months after the first procedure, in line with the principle of the “cooling-off period” and adequate postoperative rehabilitation [12]. Additionally, it has been suggested that conservative treatment should continue for at least 6 months prior to reconstructive surgery to prevent heterotopic ossification [13].

The resection of the malunited fragment of the humeral capitellum was justified based on its intra-articular location, as well as the presence of structural and morphological changes to the fragment, which were attributed to the chronic nature of the injury. Additionally, the existing elbow contracture and the possibility of a minimally invasive surgical approach were taken into consideration. Histomorphological studies [14] have demonstrated that two months or more following a fracture of the humeral capitellum, the hyaline cartilage on the articular surface demonstrates dystrophic changes and partial necrobiosis, while the cancellous bone in the distal fragment shows pronounced signs of avascular necrosis. As a result,

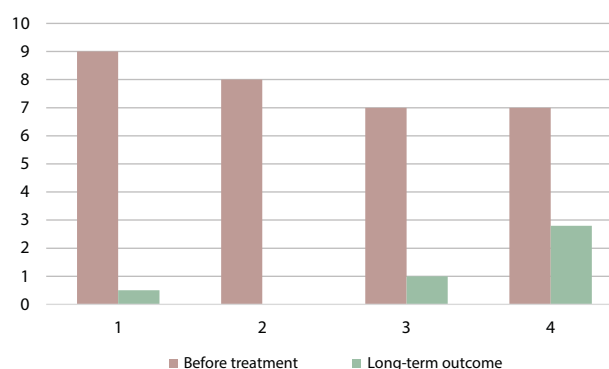


FIG. 5.

Treatment outcome diagram showing quality of life, self-care ability, pain severity (VAS), and range of motion deficit before and after treatment: 1 – quality of life impairment; 2 – limited self-care ability; 3 – pain severity (VAS); 4 – range of motion deficit (10 points – 140° deficit, 0 points – no deficit)

attempts at osteosynthesis at this stage may lead to unfavorable outcomes.

In the postoperative period, preventive measures were taken to reduce the risk of heterotopic ossification, including joint exercise with gradually increasing intensity, physiotherapy using various techniques such as magnetotherapy, terahertz electromagnetic waves, laser therapy, and phototherapy, and the use of pharmacological agents to enhance bone tissue microcirculation. Despite ongoing research into heterotopic ossification and its treatment, monitoring for this potential complication remains an essential part of patient management [15].

CONCLUSION

This clinical observation demonstrates that complex reconstructive techniques are not always necessary for restoring elbow function. The development of less invasive, pathogenetically sound surgical approaches constitutes a promising area of research, and further study into their efficacy and refinement is justified. To determine the suitability of this approach for desmogenic and combined contractures, larger samples and more extensive statistical analyses are needed.

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Conflicts of interest

The authors declare no conflicts of interest.

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