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Effectiveness of modified arthroscopic treatment of patients with epicondylitis of the humerus

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Abstract

Background One of the most common reasons of patients' visits with complaints in the area of the elbow joint is epicondylitis of the elbow joint. Surgical treatment is recommended if conservative treatment fails after 6-12 months. Arthroscopy of the elbow joint is one of the current surgical methods of minimally invasive interventions on the elbow joint. **Purpose** To conduct a comparative assessment of the effectiveness of treating epicondylitis of the elbow joint using modified arthroscopic and open techniques **Methods** A prospective cohort-controlled study was performed on 120 patients. The patients were divided into two groups: group 1 – patients operated on by the open method (control), group 2 – patients operated on by the arthroscopic method. Additionally, depending on the nosology, the patients were divided into four subgroups. Functional results were assessed using VAS, DASH, MEPS; additionally, dynamometry was performed before surgery, and 1, 3 and 12 months after surgery. **Results** There is a significant improvement in the function of the lbow joint one month after surgical treatment, mainly in III and IV subgroups according to the MEPS scale, $p = 0.0001$. According to the VAS scale, a pronounced and persistent decrease in pain in the long-term period compared with the preoperative period was revealed in patients of the arthroscopic subgroup $p = 0.0001$. According to the DASH questionnaire, the functional results in patients of arthroscopic group in the postoperative period significantly exceeded over the open method $p < 0.001$. **Discussion** The use of the open surgical method provides good or excellent functional outcomes of treatment in 75-85 %. However, it has a number of disadvantages, including infectious complications and the inability of the surgeon to identify and completely remove the pathological altered tissues. The arthroscopic technique allows leveling these shortcomings and obtaining up to 95-100 % excellent functional results. **Conclusion** Based on the data obtained in this study, the reatment of patients with epicondylitis of the distal humerus according to the developed arthroscopic technique significantly improves the functional state of patients, which, in turn, improves their quality of life.

Keywords: medial epicondylitis, lateral epicondylitis, arthroscopy, tennis elbow, elbow joint

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INTRODUCTION

One of the most common reasons for patients'visits to a doctor with complaints in the area of the elbow joint is epicondylitis of the distal humerus [1]. Patients complain of pain that worsens with physical activity. In most cases, lateral epicondylitis is diagnozed, the incidence of which is from 1 to 3 % [2]; most often females are affected by this disease, mainly at the age of 40-59 years [3]. In 80 % of cases, the symptoms relieve after conservative treatment (cold, rest, physiotherapy, corticosteroid injections) [4, 5, 6]. In case of ineffective conservative treatment within 6-12 months, surgical treatment is recommended [7]. This group includes 2-11 % of patients suffering from epicondylitis of the elbow joint [8].

The surgical treatment of enthesopathy of the distal humerus (EDH) was first mentioned by G. Hohmann in 1933, who proposed to dissect the short extensor carpi [9]. Subsequently, the techniques for EDH surgical treatment underwent changes, and other methods were proposed, such as decortication of the epicondyles of the distal humerus and dissection of the annular ligament, percutaneous dissection of the tendon of the short radial extensor of the wrist [10, 11, 12, 13].

However, these surgical manipulations were not widely used due to the incomplete satisfaction of patients with the results of EDH treatment, which prompted us to search for new minimally invasive methods of surgical treatment [14]. Arthroscopy of the elbow joint is one of the current methods of surgical treatment that allows for minimally invasive interventions on the elbow joint [15, 16]. However, elbow arthroscopy is associated with a high incidence of iatrogenic damage to neurovascular structures, the incidence of which, as reported, varies from 4 to 11 % [17, 18].

To reduce the number of iatrogenic complications, a cadaver study was performed to determine effective and safe arthroscopic approaches to the elbow joint. The study resulted in the design of an original device

that allows dissection of the tendons of the flexor and extensor muscles of the forearm. However, arthroscopic approaches and the original device were not tested in clinical practice [19]. The work is based on the dissertation research by M.R. Salikhov "Optimization of arthroscopic operations in the treatment of patients with injuries and diseases of the elbow joint (clinical and anatomical study)".

Purpose To conduct a comparative evaluation of the effectiveness of treatment of patients with epicondylitis of the elbow joint using modified arthroscopic and open techniques.

MATERIALS AND METHODS

Study design

A prospective controlled cohort study was conducted.

A comparative analysis of the results of surgical treatment of patients with epicondylitis of the elbow joint was carried out. The patients included in the study were divided into two groups: group 1 – patients operated on by the open method (control), group 2 – patients operated on by the arthroscopic method (main).

The study *included* patients aged 18 to 65 years with a history of lateral or medial epicondylitis after failed conservative treatment for six months (exercise therapy, NSAIDs, injections of glucocorticosteroids, shock wave therapy, and unloading braces). MRI was used for examination.

Exclusion criteria: history of surgical interventions for fractures of the bones forming the elbow joint, concomitant diseases such as arthrosis of the elbow joint, compression syndrome, chondromatosis, instability, rheumatological diseases of the elbow joint.

The dynamics of the recovery of the upper limb function under MRI control and examination by a traumatologist was monitored in all patients included in the study 1, 3, and 12 months after the operation.

Outcomes were assessed using the Disability of the Arm, Shoulder and Hand Outcome Measure (DASH) Questionnaire, pain was assessed using the Visual Analogue Scale (VAS). The functional assessment of the elbow joint was performed using the MEPS scale. The grip strength of the hand was assessed with a manual electronic dynamometer (registration certificate FSR 2008/02492, Russia) in the position of full extension in the elbow joint. The measurements were taken by an expert before the operation and 1, 3, 12 months after it.

General characteristics of the groups

Interventions in the patients of the main (arthroscopic) and control groups were performed in the period from 2018 to 2022 at the Vreden Medical Research Centre of the Ministry of Health of Russia. The total number of patients of both groups included in the study was 120 persons. The mean age of patients in the main and control groups was 43.9 ± 14.5 and 40.1 ± 10.2 years, respectively.

Additionally, depending on the nosology, patients were divided into four equal subgroups, each subgroup of 30 patients:

Subgroup I – patients of the control group operated on for lateral epicondylitis of the humerus by an open method;

Subgroup II – patients of the control group operated on for medial epicondylitis of the humerus by an open method;

Subgroup III – patients of the main group, operated on for lateral epicondylitis of the humerus arthroscopically;

Subgroup IV – patients of the main group, operated on for medial epicondylitis of the humerus arthroscopically.

All patients of both groups were operated on by the same surgical team of the Vreden Centre with subsequent assessment of their functional results with VAS, DASH, MEPS before surgery, 1, 3 and 12 months after surgery. Based on the foregoing, comparison of the results of surgical treatment of patients of both groups is reasonable.

Surgical techniques for management of the control group

Patients with lateral epicondylitis (subgroup I)

Patients with lateral epicondylitis underwent the Hohmann operation [9]. The operation consists in approaching the site of attachment of the extensor carpi radialis brevis to the lateral epicondyle of the humerus, followed by its disinsertion.

A crescent-shaped skin incision is made in the region of the lateral epicondyle of the humerus, 2 cm proximal to the latter, slightly moving anteriorly in the distal direction. Next, the soft tissues are cut in layers to the tendinous part of the extensor carpi radialis brevis (ECRB) between the extensor carpi radialis longus (ECRL) and the tendon of the extensor digitorum communis (EDC), after which the ECRB is released in the area of its insertion to the humerus. Then, with the help of a curette, the area of the articular surface of the humerus with the zone of its insertion to the lateral epicondyle of the humerus is cleaned from inflamed detritus. Wounds are sutured in layers. The limb is fixed with a scarf bandage until the sutures are removed.

Patients with medial epicondylitis (subgroup II)

A skin incision was made in the region of the medial epicondyle of the humerus. Next, the soft tissues are dissected in layers to the tendon tissues of the flexor carpi radialis (FCR) and the humeral head of the pronator teres (HHPT). Next, the HHPT is retracted

upward to identify the tendon of the flexor carpi radialis, after which it is excised within healthy tissues. Wounds are sutured in layers. The operated limb is fixed with a scarf bandage until the sutures are removed.

Original device

Based on these results obtained in the course of our earlier study, an original device was developed: a enotome (Fig. 1) [19]. This device allows release of the tendons of the ECRB (lateral epicondylitis) and the flexor carpi radialis (medial epicondylitis) during the surgery for epicondylitis of the distal humerus.

Fig. 1 Tenotome (original device)

Modified surgical techniques for patients of the main group

Patients with lateral epicondylitis (subgroup III)

Based on the results of topographic anatomical and clinical studies, we have developed a technique for arthroscopic treatment of patients with lateral and medial epicondylitis of the humerus. Surgical technique: the patient lies on a healthy side (Fig. 2), the affected upper limb is fixed with a shoulder rest in the position of flexion at the elbow joint to an angle of 90° (it is in this position that the maximum distance from the radial, median nerves and brachial artery to the bone structures is noted) . Optical arthroscopic appoach is performed on the medial surface of the joint, above the mid-humeral line at a point 2.0 cm proximal and 0.5 cm anterior to the medial epicondyle of the humerus. The trocar should be passed through the approach along the anterior surface of the humerus in the direction of the glenohumeral joint. Next, using a needle, the topography of the anterolateral (instrumental) approach is identified (Fig. 3c), through which the joint capsule is resected with a high-frequency ablator and a shaver (Fig. 3e); next the tendon of the ECRB is visualized. Then, through the instrumental approach to the joint cavity, a tenotome is introduced (Fig. 3f), which is used to capture the damaged ECRB tendon (Fig. 2g) and cut it (Fig. 3h).

Patients with medial epicondylitis (subgroup IV)

The positioning of the patient is similar to that in subgroup III (Fig. 2). Optical arthroscopic approach is performed on the lateral surface of the joint above the median brachioradial line at a point 1.0 cm distal and 1.0 cm anterior to the lateral epicondyle of the humerus. The trocar should be passed through the formed approach along the anterior surface of the humerus in the direction of the medial epicondyle. Next, using a needle, the topography of the proximal medial (instrumental) access is identified, through which the joint capsule is resected with a high-frequency ablator and a shaver, after which the flexor carpi radialis (FCR) tendon may be visualized. Then, through the instrumental access to the joint cavity, a tenotome is introduced, which captures the affected tendon (FCR) and cut it.

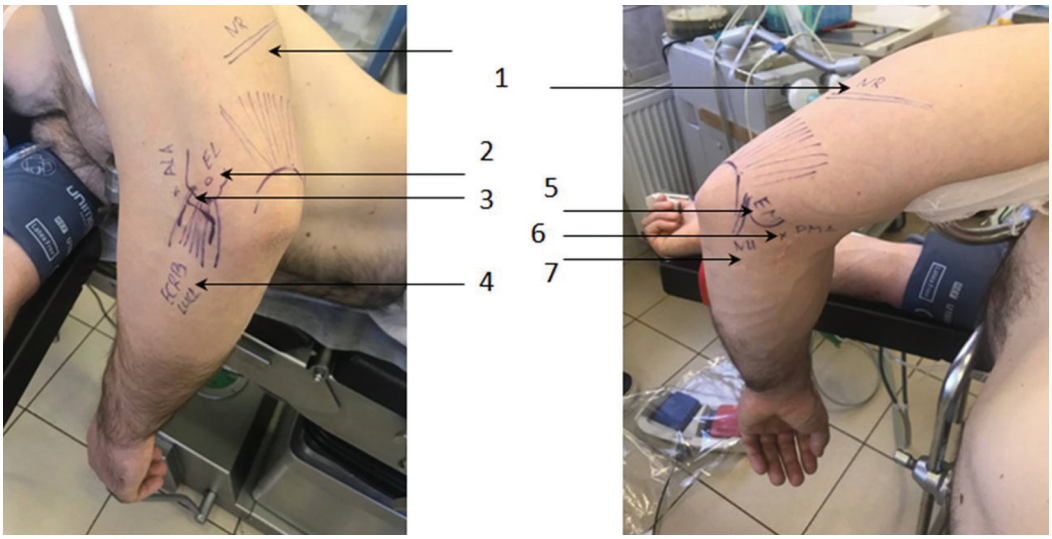

Fig. 2 Preoperative position of the patient on the operating table, anatomical landmarks are marked on the skin: 1 – radial nerve; 2 – lateral epicondyle of the humerus; 3 – direct lateral approach; 4 – extensor carpi radialis brevis; 5 – medial epicondyle of the humerus; 6 – ulnar nerve; 7 – proximal medial approach

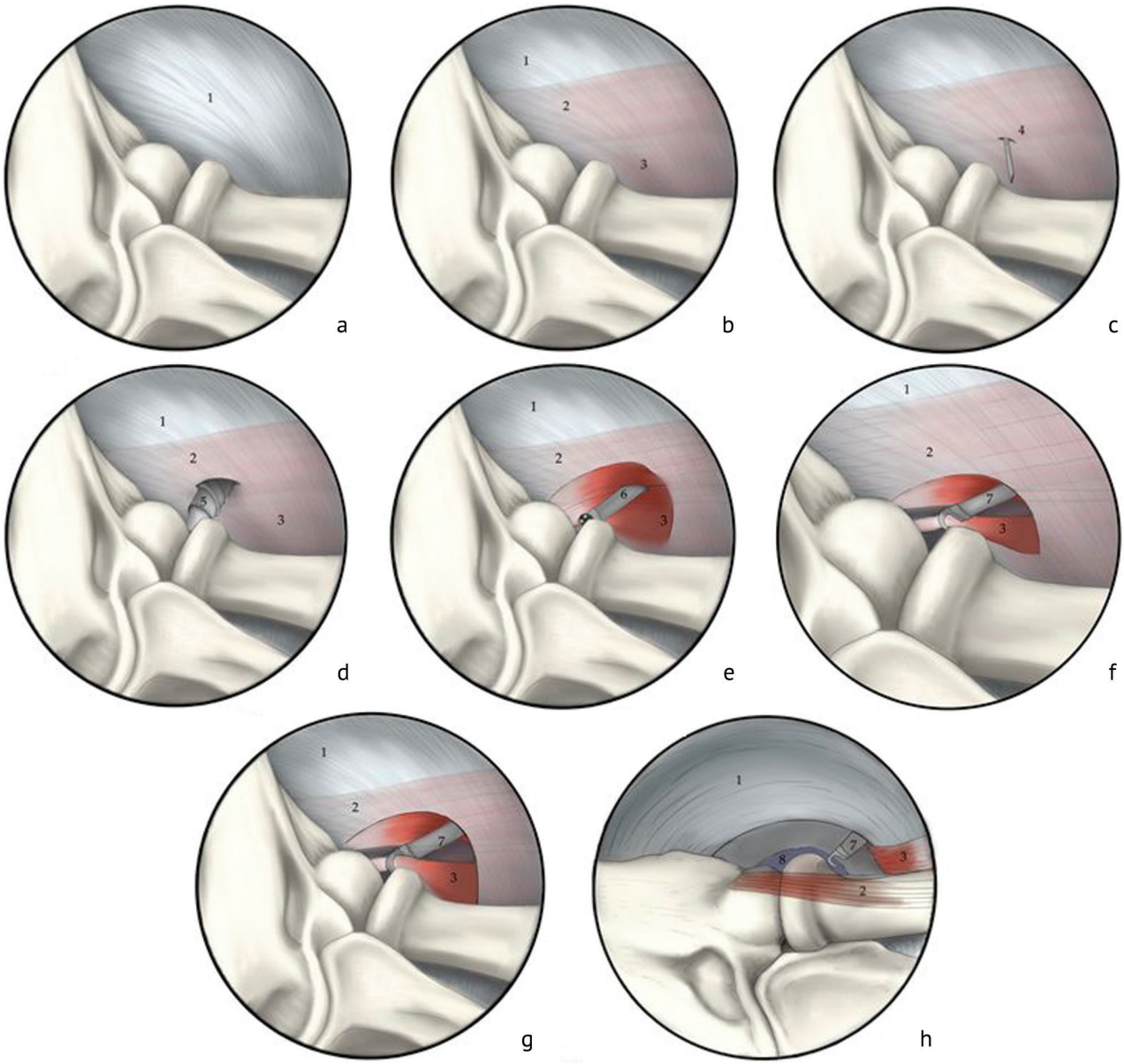

Fig. 3 Stages of surgical treatment of lateral epicondylitis: 1 – joint capsule; 2 – extensor carpi radialis longus; 3 – extensor carpi radialis brevis; 4 – needle; 5 – cannula with an obturator; 6 – vaporizer; 7 – tenotome; 8 – radial collateral ligament

Statistical analysis

Data processing was carried out using a specialized software Past (PAleontological STatistics) 306. The normality of the distribution of quantitative data was checked using the Shapiro criterion. Well-distributed quantitative data are presented as means, standard deviation, and 95 % confidence interval, Student's t-test was used to compare the groups. The dynamics of indicators was assessed using the t-test for dependent samples. For non-normally distributed data, values are presented as median, upper and lower quartiles (Q1-Q3). Statistical comparisons with the VAS, the MEPS functional questionnaire, the duration of surgical treatment in patients of both groups were performed using a nonparametric method of statistical analysis, namely the Mann-Whitney test. The dynamics of these indicators was assessed using the Wilcoxon test.

RESULTS

Between 2018 and 2022, 120 patients gave their consent to participate in the study. All participants were divided into 2 clinical groups. Both groups were divided into two equal subgroups. The distribution of patients by groups is shown in Figure 4.

The average duration of the operation was longer for open interventions than for arthroscopic ones: 48.0 min (standard deviation (SD) ± 23.5 min.) vs 21.8 min (SD ± 5.1 min.).

It should be noted that all patients of the main and control groups were comparable in terms of gender and age, the severity of pathology ($p > 0.05$), the results are presented in Table 1.

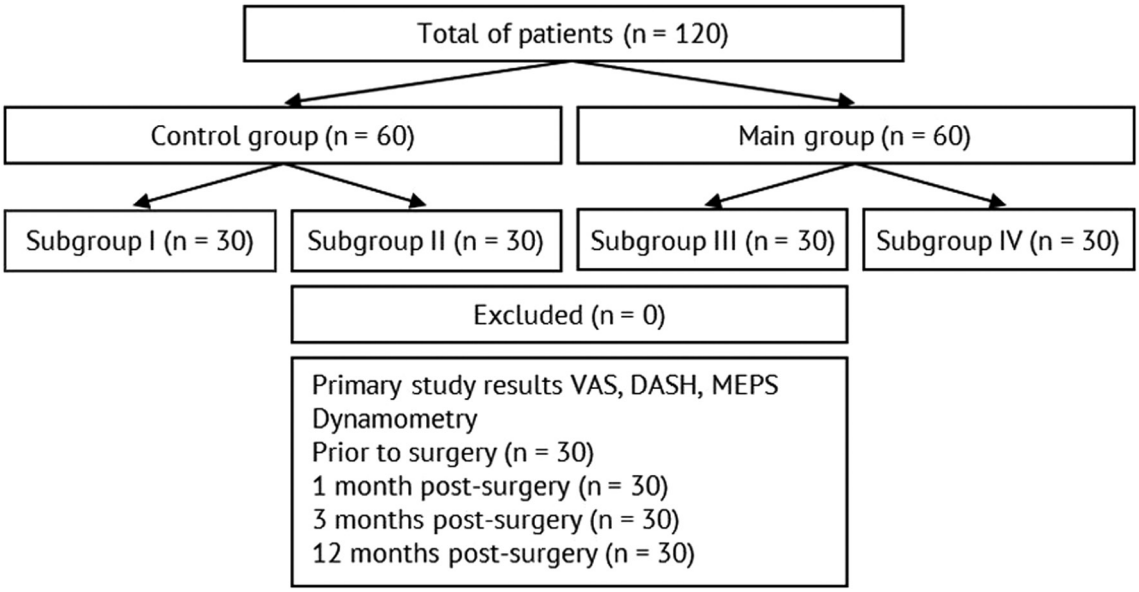

Fig. 4 Distribution of patients

Table 1

Gender and age of the patients

Parameter	Control group	Main group	p, Value
Age, years	40.1 ± 10.2	43.9 ± 14.5	> 0.05
Gender (M/F), n(%)	33(55 %)/27(45 %)	40(66.6 %)/20 (33.3 %)	> 0.05

During the surgical interventions not a single complication associated with damage to the neurovascular or tendon-muscular structures as well as infectious complications in the elbow joint area was recorded in patients of two clinical groups.

The results in patients of both groups, assessed by the MEPS scale before surgery, 1, 3 and 12 months after the operation, are presented in Table 2. The function of the elbow joint according to the MEPS scale improved mainly in arthroscopic subgroups after the operation; thus, in subgroup III, the increase in Me was by 35.5 ($p = 0.0001$), in subgroup IV by 35 ($p = 0.0001$) (Table 2, Figures 5, 6).

Functional results of treatment of patients in the control group, assessed with the MEPS, are shown in Figures 5 and 6.

Table 2

MEPS functional results before and 1, 3 and 12 after surgical treatment, points

Time point	Subgroup	Result values		
		Me	[Q1:Q3]	p*
Before surgery	I	61	[55:65]	0.0237
	III	58.5	[52:61]	
	II	52	[49:61]	0.5845
	IV	59	[47:61]	
1 month post-surgery	I	54	[49:61]	0.0001
	III	76	[76:91]	
	II	54	[51:61]	0.0001
	IV	76	[76:91]	
3 months post-surgery	I	75	[75:78]	0.0001
	III	91	[90:92]	
	II	61	[56:74]	0.0001
	IV	92	[91:93]	
12 months post-surgery	I	89	[76; 89]	0.0001
	III	94	[93:95]	
	II	76	[76:91]	0.0001
	IV	94	[93.7:95]	

* – comparison of the control and main groups

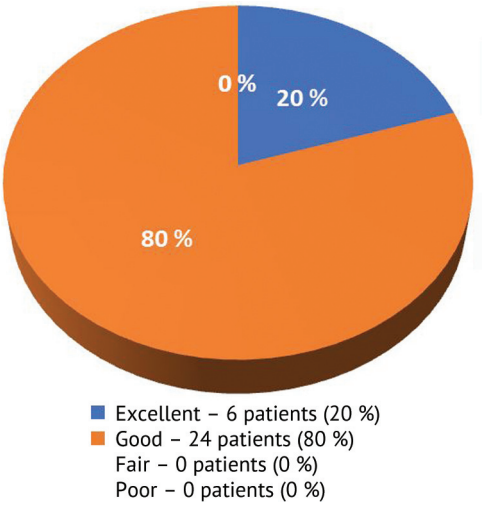

Fig. 5 Functional result according to the MEPS system after open treatment in patients with lateral epicondylitis 12 months after surgery

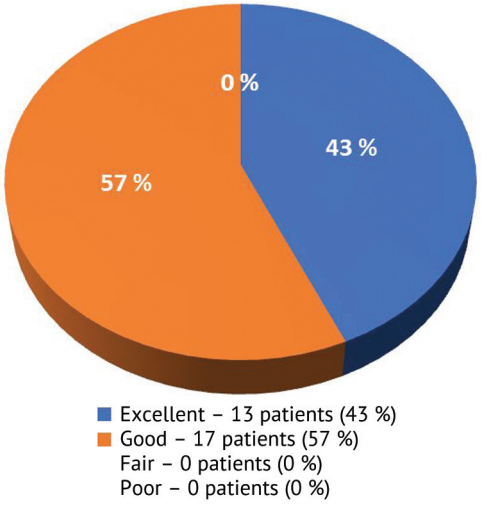

Fig. 6 Functional result according to the MEPS system after open treatment in patients with medial epicondylitis 12 months after surgery

The functional results of treatment in the arthroscopic (main) group according to the MEPS questionnaire after 12 months since the surgery were rated as excellent in all cases.

Positive dynamics and a decrease in the intensity of pain were noted at all periods of observation in comparison with preoperative indicators when the severity of pain was analyzed in patients of the arthroscopic group according to the VAS scale. In a comparative analysis of mean VAS scores 12 months after surgery, a significantly smaller difference was noted in the arthroscopic group compared to the group with open surgery ($p < 001$) (Fig. 7 and 8).

Patients of the arthroscopic subgroup showed a significant improvement in grip strength of the hand (Me, DaH) 12 months after surgical treatment. Thus, in patients with medial epicondylitis, Me hand grip strength improved by 17 DaN (from 21 to 38 DaN) and in patients with lateral epicondylitis, Me hand grip strength improved by 24.2 DaN (from 18.8 to 43 DaN) (Table 3).

In turn, there was a slight improvement in patients operated on by the open method as compared to the patients in the arthroscopic group. Thus, the Me grip strength of the hand improved by only 8 DaN (from 21 to 29 DaN) in patients with medial epicondylitis. In patients with lateral epicondylitis, Me of hand grip strength improved by 114.25 DaN (from 16.75 to 31 DaN).

According to the data obtained during the assessment of the functional state of the elbow joint according to the DASH questionnaire in the postoperative period, the decrease in the scores in the arthroscopic subgroups significantly exceeded those in the open subgroups, $p < 0.001$. Thus, in the patients of the arthroscopic subgroups III and IV, Me decreased by 43.2 and 45.6 (Table 4).

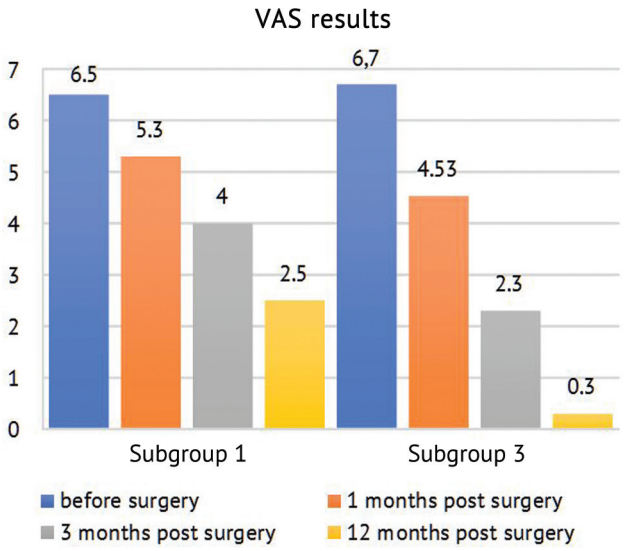

Fig. 7 Assessment of pain according to VAS before and after surgical treatment in patients with lateral epicondylitis

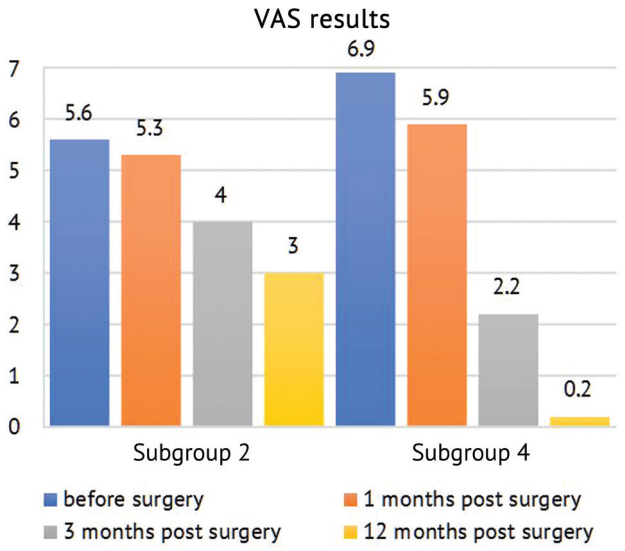

Fig. 8 Assessment of pain according to VAS before and after surgical treatment in patients with medial epicondylitis

Table 3

Dynamometry results in patients of both groups before and 1, 3 and 12 months after surgical treatment (DecaNewtons)

Time-point	Subgroup	Result values		
		Me	[Q-1:Q-3]	p*
Before surgery	I	16.75	[13.8:20.3]	0.0533
	III	18.8	[17:24]	
	II	21	[18:23]	0.3601
	IV	21	[14.5:24]	
1 month post-surgery	I	24.25	[21:26]	0.0001
	III	34.5	[28.7:40]	
	II	20	[16.75:22.25]	0.0001
	IV	28	[25:34.75]	
3 months post-surgery	I	29	[25.75:33]	0.0001
	III	38.5	[30.75:45.5]	
	II	24	[20.75:27]	0.0001
	IV	32.5	[29.75:39.25]	
12 months post-surgery	I	31	[30:33.25]	0.0001
	III	43	[38.7:48]	
	II	29	[27.75:30.25]	0.0001
	IV	38	[33,75:43]	

* – comparison of the control and main groups

Table 4

DASH functional results in patients of both groups before and 1, 3 and 12 months after the surgery (points)

Time-point	Subgroup	Result values		
		Me	[Q-1:Q-3]	p*
Before surgery	I	53.9	[44.15:69.2]	0.0898
	III	47.2	[32.6:68.5]	
	II	43.3	[33.3:52.7]	0.8737
	IV	47.8	[35.8:58.7]	
1 month post-surgery	I	32.2	[27.9:36.7]	0.0147
	III	27.4	[19.8:33.3]	
	II	47.9	[40:53.8]	0.0001
	IV	30.9	[25.8:36.7]	
3 months post-surgery	I	21.2	[15.8:24.7]	0.0004
	III	16	[15.3:16.8]	
	II	32	[25.8:37.2]	0.0001
	IV	19	[13.3:25.8]	
12 months post-surgery	I	16.1	[15.3:19.8]	0.0001
	III	4	[3:5]	
	II	22	[14.1:25.8]	0.0001
	IV	2.2	[1.75:2]	

* – comparison of the control and main groups

DISCUSSION

There are many open methods of surgical treatment of distal humerus epicondylitis, including excision of angiofibrous tissue in the area of tendon insertion to the epicondyles, followed by decortication; fasciotomy of the extensor tendons; V-shaped shifting of the common tendon of the extensors; denervation of the lateral epicondyle, resection of the epicondyle with transfer and lengthening of the ECRB tendon [20, 21, 22].

The use of the open surgical method provides good or excellent functional treatment outcomes in 75-85 % of cases and allows patients to return to everyday or sports activities [9, 10]. However, a significant number of patients have a long recovery period, and poor results are observed in 7-11 % of cases [23, 31]. Thus, according to our study, patients who underwent open excision of tendon structures had excellent and good results on the MEPS, DASH scale. VAS scores in patients of both subgroups revealed that residual pain persisted (average 2.5 points in subgroup I and 3 points in subgroup II); however, this pain did not affect household or other life activities. The number of unsatisfied patients in both clinical groups was 0%.

The world literature presents a number of reasons for poor results after surgical treatment, including incorrect diagnosis, the inability of the surgeon to identify and completely remove pathologically altered tissues [24]. With the development of arthroscopic techniques for the treatment of patients with epicondylitis of the distal

humerus, it became easier to identify the pathologically altered tissues and to excise them without damaging healthy structures [25].

However, the arthroscopic method of treatment requires special equipment and certain surgical skills. According to the literature, various complications occur after arthroscopic interventions on the elbow joint and in most cases associated with damage to the neurovascular and tendon-ligament structures of the elbow joint [14, 26]. The data obtained in the course of our study show that there was not a single iatrogenic complication associated with damage to the structures that form the elbow joint by performing arthroscopic interventions on the elbow joint. To level the risks of damage to the neurovascular and tendon-ligamentous structures, approaches were used that were proposed after having performed a topographic and anatomical study of the structures that form the elbow joint [19].

Based on DASH, VAS, MEPS and dynamometry results, the best functional outcomes were achieved in patients operated on with a modified arthroscopic method. According to the literature, some authors attempted to compare the effectiveness of various surgical methods for the treatment of patients with epicondylitis. Thus, Rubenthaler et al. compared the results of elbow joint treatment with open intervention and with arthroscopy in 2005. After having compared the treatment outcomes at follow-ups of 10 and 13 months, no significant differences were found [11]. Similar results were obtained by Peart et al. in 2004. The authors noted that the patients returned to work earlier after arthroscopic interventions on the elbow joint, [27].

Kwon et al. (2017) did not note significant differences in DASH functional outcomes, but found a difference in the VAS assessment of pain: 1.6 ± 1.3 in the open surgery group compared to 2.2 ± 2.0 points in the arthroscopy group ($p = 0.042$) [28]. In the course of our study, the data were obtained that had a significant difference. Thus, when assessed with DASH scale in arthroscopic subgroups III and IV, Me decreased by 43.2 and by 45.6 ($p < 0.001$).

Studies comparing arthroscopic and open methods of surgical treatment of elbow joint epicondylitis show a longer duration of surgical treatment with the use of arthroscopic techniques [11].

In domestic medicine, data on the treatment of epicondylitis of the distal humerus are scarce.

Salikhov et al. compared the effectiveness of open and arthroscopic methods of treatment in 2017. The best scores on the VAS and MEPS scales were obtained in the arthroscopic group without decortication. Based on the results of the study, the authors came to the conclusion that decortication leads to an increase in postoperative pain, a decrease in the range of motion in the limb, thus imposing difficulties in returning to sports activities [29].

In 2018, Kachesov et al published the results of surgical treatment of patients with lateral and medial epicondylitis of the distal humerus [30]. The effectiveness of surgical treatment was assessed using the VAS, DASH, and MEPS scales; hand grip dynamometry was additionally performed 3, 6, and 12 after surgery. In the first group, patients underwent denervation of the lateral epicondyle of the distal humerus; in the second group, the operation was performed according to the Morray method; in the third group the author's own method was used that involves performing monocortical perforation of the lateral epicondyle of the humerus with excision of dystrophically changed tissues, as well as performing in a checkerboard-like transverse perforation of the aponeurosis. Short-term results were better in the denervation group, which can be explained by the minimal trauma of the intervention. However, 12 months after the operation, there was a significant deterioration in the functional parameters of the elbow joint and the return of pain. According to the authors, it occurred due to the fact that no impact on the pathological focus was carried out. The best result was found in the group of patients who were treated according to the method proposed by the authors, which was the most radical.

According to a Cochrane review published in 2011, there was no statistical difference between the outcomes of surgical treatment of patients with lateral epicondylitis of the distal humerus. The work included 5 original studies summarizing the experience of surgical treatment of 191 patients after failed conservative treatment for 5 months. Surgical treatment included open release of the ECRB tendon, percutaneous ECRB release, and decompression of the posterior interosseous nerve [31].

The analysis of the treatment results of the patients in our study led to the conclusion that the optimized method of arthroscopic treatment can achieve a significant improvement in the functional state of patients, which, in turn, improves their quality of life.

CONCLUSION

The data obtained in this study show that the treatment of patients with epicondylitis of the distal humerus with the optimized arthroscopic technique can significantly improve the functional state of patients.

The decision whether to choose an arthroscopic or open treatment techniques should be based on the status of each patient, as well as on the experience and preferences of the surgeon.

Conflict of interest *The authors declare that they have no competing interests.*

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Ethics approval *This study was reviewed and approved by the local ethics committee of the Vreden Centre of the Ministry of Health of Russia, protocols No. 2 of 04/05/2021.*

Consent for publication *Not required.*

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Contribution of the authors:

All authors made equal contributions to the study and the manuscript.
All authors read and approved the final version of the manuscript.
All authors agree to bear responsibility for all aspects of the study to ensure proper consideration and resolution of all possible issues related to the correctness and reliability of any part of the work.