УДК 618.5-089.888:[616.747:616.8-009.1]](045)

DOI: http://dx.doi.org/10.15674/0030-59872025478-86

Analysis of the results of surgical treatment of patients with the consequences of obstetric Duchenne-Erb paralysis

A. M. Hrytsenko, S. O. Khmyzov, O. G. Shevchenko, I. M. Harbuzniak, T. A. Yermak, R. V. Zlatnik

Sytenko Institute of Spine and Joint Pathology National Academy of Medical Sciences of Ukraine, Kharkiv

To improve upper limb function in obstetric palsy, a number of surgical techniques have been proposed worldwide. However, achieving the desired rehabilitation effect is not always possible. Objective. To analyze the treatment outcomes in patients with the sequelae of Duchenne–Erb obstetric palsy depending on the severity of pathology, the diagnostic methods applied, and the chosen surgical tactics. Methods. A retrospective and prospective study was conducted to evaluate the treatment outcomes of children with Duchenne–Erb obstetric palsy who underwent surgery at the Pediatric Orthopedics Department of the SI «Sytenko Institute of Spine and Joint Pathology of the National Academy of Medical Sciences of Ukraine». The retrospective group consisted of 6 patients; the prospective group included 16 patients, divided into two subgroups of eight: Group I — without bony deformities; Group II — with secondary bony deformities. Tendon-muscle transfers were performed in Group I, while a two-stage surgical intervention was applied in Group II. Parents of the children completed questionnaires. Results. In the retrospective group, after L'Episcopo surgery, an improvement in the function of the affected limb according to the Mallet scale was observed in two patients, while in the prospective group (in the long-term postoperative period) improvements were recorded in 10 cases. Group II demonstrated more pronounced and statistically significant positive changes in upper-limb function ($p < 0.05$). The frequency of functional improvement according to the Mallet scale between the prospective and retrospective groups did not reach statistical significance ($p > 0.05$). Differences in postoperative muscle strength between Groups I and II were not statistically significant ($p > 0.05$). After treatment, parents' assessment of their child's functional status increased by (5.1 ± 1.3) points, satisfaction with life — by (4.3 ± 1.3) points, and overall quality of life — by (9.4 ± 2.6) points ($p < 0.001$). Conclusions. A differentiated approach to choosing treatment tactics allows not only improving the function of the affected limb but also enhancing patients' quality of life, improving their psycho-emotional state, and increasing life satisfaction.

Із метою поліпшення функції верхньої кінцівки в разі акушерського паралічу у світі запропоновано низку методик оперативних втручань. Утім, досягти бажаного ефекту реабілітації хворого вдається не завжди. Мета. Проаналізувати результати лікування пацієнтів з наслідками акушерського паралічу Дюшена-Ерба залежно від тяжкості патології, застосування методів діагностики та тактики хірургічного втручання. Методи. Проведено ретроспективне та проспективне дослідження результатів лікування дітей з акушерським паралічем Дюшена-Ерба, яким виконували операцію в клініці дитячої ортопедії ДУ «ІПХС ім. проф. М. І. Ситенка НАМН України». Ретроспективну групу склали 6; проспективну — 16, їх розподілили на дві підгрупи по 8 осіб: I — без кісткових деформацій; II — хворі зі вторинними кістковими деформаціями. Пацієнтам I підгрупи виконано сухожилково-м'язові транспозиції, II — двохетапне хірургічне втручання. Проведено анкетування батьків дітей. Результати. У ретроспективній групі після втручання за методикою L'Episcopo покращення функції ураженої кінцівки за шкалою Mallet спостерігалось у двох хворих, а у проспективній (у віддаленому післяопераційному періоді) — у 10 випадках. У II підгрупі зафіксовано більш виражені та статистично значущі позитивні зміни функціонального стану верхньої кінцівки ($p < 0,05$). Частота покращення функціонального стану ураженої кінцівки за шкалою Mallet серед пацієнтів проспективної та ретроспективної груп не мала статистичної значущості ($p > 0,05$). Відмінності показників сили м'язів після операції у I та II підгрупах були статистично не значущі, $p > 0,05$. Після лікування оцінка функціонального стану хворої дитини з погляду батьків збільшилась на (5,1 ± 1,3) бала, задоволеності життям — на 4,3 ± 1,3, загальна якість життя — на (9,4 ± 2,6) бала ($p<0,001$). Висновки. Диференційований підхід до вибору тактики лікування дозволяє не лише покращити функцію ураженої кінцівки, а й підвищити якість життя хворих, поліпшити їхній психоемоційний стан і задоволеність життям. Ключові слова. Акушерський параліч Дюшена-Ерба, плечовий суглоб, вторинні кісткові деформації, плечове сплетення, м'язові транспозиції, шкала Mallet, хворобо-специфічний інструмент.

Key words. Duchenne-Erb obstetric palsy, shoulder joint, secondary bone deformities, brachial plexus, muscle transpositions, Mallet scale, disease-specific instrument

Introduction

Erb-Duchenne obstetric paralysis (Erb's paralysis due to birth trauma according to ICD-10, code P14.0) is the most common impairment among brachial plexus injuries.

The disease progresses through three distinct stages:

– Acute period (during the first 3 months after birth);

– Recovery period (from 3 months to 3 years);

– Residual signs (from 3 years and continuing throughout life).

Most injuries are of a neuropraxic nature, which over time allows for partial recovery of limb function. Recovery of nerve structures is more effective when treatment is applied during the first two periods of the disorder [1–3]. In the stage of residual signs, nerve innervation of the limb is generally not recoverable, and the treatment approach involves reconstructive-plastic orthopedic interventions to eliminate joint contractures and increase the range of function.

Considering this, it is particularly important in the treatment of Erb-Duchenne obstetric paralysis (EDOP) to use a broad diagnostic toolkit as early as possible, including X-ray, ultrasonography (US), electromyography (EMG), electroneurography (ENG), computerized tomography (CT), magnetic resonance imaging (MRI), and others. Additionally, timely and qualified application of a comprehensive treatment strategy during each period of the disease depending on the severity of the injury is significant, including pharmacological, physiotherapy, orthotic treatment, and, if necessary, surgical intervention [3–8]. When conservative treatment is the only approach, limb function in patients with EDOP is restored up to 55–70 % of cases by the age of three, depending on the severity of the injury [9].

To improve the function of the upper limb in cases of obstetric paralysis, several surgical techniques have been proposed worldwide, directly targeting nerve structures, the tendon-muscle system, bones, and joints. However, each surgical treatment method has a certain percentage of complications and failure to achieve the desired rehabilitation effect [10].

Objective: To analyze the results of treatment in patients with the consequences of Erb-Duchenne obstetric paralysis depending on the severity of the pathology, the application of diagnostic methods, and the tactics of surgical intervention.

Materials and Methods

The study materials were reviewed and approved by the Bioethics Committee (protocol dated 19 May 2025, No. 252) of Professor M. I. Sytenko Institute of Spine and Joint Pathology of the National Academy of Medical Sciences of Ukraine. The parents of all patients gave informed consent.

The treatment results of 22 patients aged 3 to 13 years with the consequences of EDOP, who were admitted to Professor M.I. Sytenko Institute of Spine and Joint Pathology during the periods 1996–2003 (retrospective study) and 2014–2022 (prospective study), were analyzed.

For the retrospective study and analysis of treatment results of EDOP, 6 medical histories were selected from patients aged 4 to 11 years. Among them were 3 girls and 3 boys, with an average age of (7.3 ± 2.8) years. Right brachial plexus injury was observed in 5 patients and left brachial plexus injury in 1 patient.

The prospective group consisted of 16 patients with EDOP aged from 3 to 17 years, including 10 boys (62.50 %) and 6 girls (37.50 %), with an average age of (10.1 ± 6.1) years. Right brachial plexus injury was observed in 6 patients and left brachial plexus injury in 10 patients. In 8 patients, bone deformities were diagnosed: elevation, rotation, and shear deformation of the scapula (SHEAR), including 2 cases on the right side and 6 on the left.

The patients in the prospective group (n = 16) were additionally divided into two subgroups based on the severity of pathological changes and types of surgical interventions:

– Group I (n = 8) — individuals with no diagnosed bone deformities who underwent active tendon-muscle transpositions;

– Group II (n = 8) — children with secondary bone deformities who underwent active tendon-muscle transpositions combined with osteotomy of the upper limb girdle bones.

All patients underwent clinical examination, including range of motion (ROM) evaluation in the affected shoulder joint using the “0” pass method. The function of the joint and upper limb was assessed using the modified Mallet scale [11], along with X-ray and electrophysiological examinations. Children in the prospective group with SHEAR bone deformity were additionally referred for CT with multiplanar reconstruction of the shoulder joint and scapula.

X-ray examinations of the shoulder joint were performed in anteroposterior and lateral projections, visualizing the scapula before surgical treatment in patients with significant adduction and internal rotation contractures, including 4 patients from the retrospective group and 8 from the prospective group. X-ray and fluoroscopy systems OPERA T90cex were used. The main criteria for identifying the presence or absence of SHEAR deformity were the position of the humeral head in the joint socket and the scapula standing height.

For the retrospective group, EMG (electromyography) was performed on both upper limbs, examining the bioelectrical activity of the shoulder girdle muscles: *m. supraspinatus, m. deltoideus, m. biceps, m. triceps, m. latissimus dorsi, and m. pectoralis major.*

For the prospective group, electrophysiological examination included performing both interference and stimulating EMG. The first bioelectrical activity was recorded bilaterally during maximum voluntary contraction of the following muscles: *m. deltoideus, m. supraspinatus, m. biceps brachii, m. triceps, m. abductor pollicis brevis,* and *m. abductor digiti minimi.* For stimulating EMG, the brachial plexus point (Erb's point) was stimulated, and motor responses from *m. deltoideus, m. supraspinatus, m. biceps brachii, m. triceps, m. abductor pollicis brevis,* and *m. abductor digiti minimi* were recorded. Latency, amplitude, and duration of M-responses were measured from the median, ulnar, axillary, radial, and musculocutaneous nerves. Reference values from the literature were accepted as normal [12]. Signals were recorded on a four-channel electromyograph ("NeuroMVP"). The input signal range was 30 mV, lower frequency 20 Hz, and upper frequency 10,000 Hz.

The results of each patient's examination before surgical intervention and in the long-term postoperative period (2–4 years later) were recorded in a specially designed questionnaire. During the observation of the prospective group, the muscle strength of the upper limbs was also evaluated using the modified Medical Research Council (MRC) scale [13]. Furthermore, to assess the quality of life of the patients before and after treatment, parents of the affected children were surveyed using the modified Disease-Specific Questionnaire (DSQ) [14]. This questionnaire included relevant questions for children with impaired upper limb function due to EDOP, focusing on functional status and ability to perform daily activities (functional scale), as well as on psychological well-being and life satisfaction (satisfaction scale).

To compare quantitative changes, the t-test for independent samples was used. Frequency data were compared using Fisher's exact test (ϕ^*). A difference was considered statistically significant if $p \leq 0.05$.

Results and Discussion

According to the clinical examination results of shoulder joint and upper limb function using the Mallet scale in the preoperative period, among the patients in the retrospective group, 4 individuals showed second-degree limitation (Mallet II), and 2 patients showed third-degree limitation (Mallet III). During the X-ray examination at the preoperative stage, no bone changes were found in 2 individuals, while in 4 patients, hypoplasia of the shoulder joint socket and subluxation of the humeral head were observed (Fig. 1). According to EMG data, all patients had a 30 % reduction in the electrical bio-potentials of the upper limb muscles compared to the healthy contralateral side.

All 6 patients in the retrospective group underwent intervention using the L'Episcopo method [15]: the subscapularis muscle was transposed to the tendon of the teres minor muscle, and the attachment point of the teres major muscle was moved to the posteromedial surface of the humerus. As a result, the internal rotators of the shoulder joint were repositioned into the external rotator position. After 2–4 years following the treatment, 2 (33.3 %) patients showed improved function of the affected limb, from Mallet II to Mallet III (Table 1).

Among the patients in the prospective group, clinical examination results before surgery showed functional limitation of the upper limb at the Mallet II level in 4 (25.0 %) cases, Mallet III in 11 (68.8 %), and Mallet IV in 1 (6.2 %) patient.

More significant functional impairments were found among patients in Group II. In this subgroup, functional limitations were observed at Mallet II in 3 (37.5 %) and at Mallet III in 5 (62.5 %) individuals.

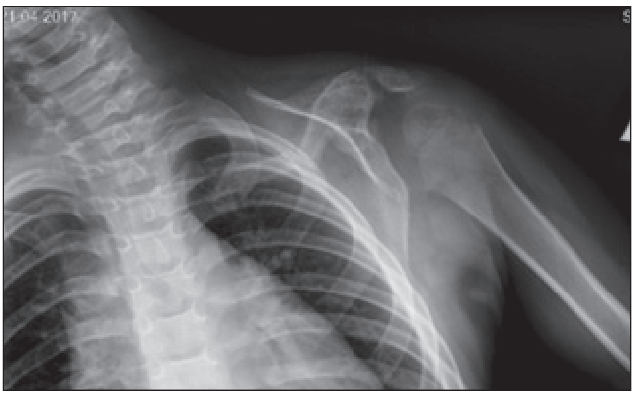

Fig. 1. X-ray of a 7-year-old patient S. Hypoplasia of the scapular glenoid cavity, posterior subluxation of the humeral head.

In Group I, limitations at the Mallet II level were noted in only 1 (12.5%) patient, at Mallet III in 6 (75.0 %), and at Mallet IV in 1 (12.5 %).

According to X-ray studies, in the preoperative period, among the 16 patients in the prospective group, 8 patients showed flattening of the humeral head with partial deformation of the shoulder socket, 2 patients had subluxation of the acromioclavicular joint and Looser's zone in the acromial process of the scapula, 3 patients had hypoplasia of the shoulder socket, subluxation of the humeral head, and in 3 additional cases, hypoplasia of the clavicle and shoulder socket, along with subluxation of the humeral head (Fig. 2).

In all patients of the prospective group, there was significant paresis of the affected limb muscles at the start of treatment. Muscle strength assessment using the MRC scale in Group I ranged from 16 to 22 points, with an average of 19.5 ± 2.3 ($p < 0.001$). Among individuals in Group II, the muscle strength of the affected limb was somewhat lower: the maximum score on the MRC scale was 19, the minimum was 14, and the average was 16.3 ± 1.5 ($p < 0.001$). The differences between the average muscle strength values in the affected limb in Group I and Group II before treatment were statistically significant, $p < 0.01$.

Table 1

Dynamics of functional status evaluation of the upper limb using the Mallet scale after surgical treatment in patients of the retrospective group (n = 6)

Dynamics of evaluation using the Mallet scale	Patient
Improvement in the function of the affected limb	2
Functional status of the affected limb unchanged:	
– Mallet II;	2
– Mallet III	2

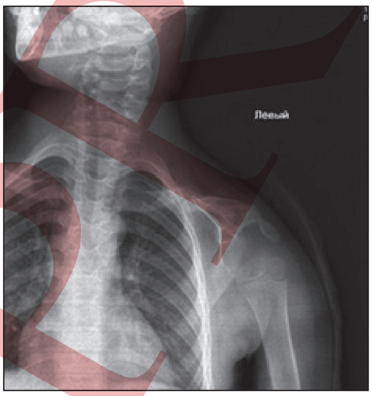

Fig. 2. X-ray of a 9-year-old patient T. Hypoplasia of the left scapula's glenoid, hypoplasia of the distal part of the left clavicle, subluxation of the left humeral head downward and backward.

To further clarify the assessment of muscle functional capacity and the severity of limb injury, EMG studies were conducted on 8 children from the prospective group. 5 of them underwent stimulation methods, 2 received total surface myography, and in 1 case, both studies were performed. The analysis was done by comparing motor response indicators from the healthy and affected limbs. Electrophysiological data were highly variable: a reduction in the amplitude of the motor response, as well as prolonged latency and duration, was observed. For example, 3 patients were found to have a reduction in the amplitude of the deltoid muscle M-response, ranging from 28 % to 64 %, and an increase in latency and duration of the M-response up to 49 %. In 1 patient, the amplitude of the deltoid muscle was 33 % higher than in the healthy limb, but in other cases, there was no significant difference between the affected and healthy limbs.

Regrettably, the preoperative evaluation did not include testing of the *pectoralis major, teres major,* or *teres minor muscles*, as there was no established diagnostic algorithm available. However, dysfunction of these specific muscles is critical in the development of internal rotation contractures in the shoulder joint and secondary bone deformities of the shoulder girdle. Given that electrophysiological studies in patients with obstetric paralysis allow for accurate diagnosis of damage localization, severity, and the degree of neurological deficit in the brachial plexus [12, 16], the results of EMG were an important marker for choosing the surgical intervention strategy and further patient monitoring.

Considering the significant pathological changes identified during clinical and X-ray examinations, 5 patients in Group II underwent CT scanning, which revealed hypoplasia and rotation of the scapula. Additionally, in 4 (80%) cases, hypoplasia of the humeral head and glenoid (shoulder socket) hypoplasia were also diagnosed (Fig. 3). On average, the hypoplastic scapula was 12 % smaller than the contralateral side. Scapular hypoplasia and its rotational deformation changed the angle of the acromioclavicular joint, which could later provoke an impingement syndrome with the humeral head [11].

In these cases, performing CT scans with 3D modeling was deemed essential for diagnosing and detailing secondary bone deformities, SHEAR deformities, and for clarifying the surgical intervention plan. However, CT scanning could not be applied to all patients for diagnostic purposes due to significant limitations for younger age groups, considering the radiation dose: X-ray — 0.1 mSv, and CT (low-dose protocols) — 2.2–3.3 mSv [17–19]. Furthermore, sedation is required for such procedures in children, which often causes negative reactions from parents and leads to refusals.

Considering the localization, severity, and degree of manifestation of neurological deficits and bone deformities detected during diagnostics, appropriate surgical tactics and methods were selected for each case.

In Group I, no bone deformities were identified during the diagnostic procedures. To improve external rotation of the shoulder joint and abduction of the arm, patients in this subgroup underwent tendon-muscle transpositions. The surgical procedure involved the transposition of the latissimus dorsi and teres major muscles to the teres minor muscle, as well as a release of the pectoralis major muscle. Additionally, depending on the severity of the pathology, subscapularis muscle separation and decompression of the axillary nerve were performed.

Given that Group II had more severe manifestations of the impairment, with significant secondary bone deformities, these patients underwent two sequential surgical interventions on the bones and soft tissue structures of the shoulder girdle with a time gap of one year between the stages. Initially, surgical correction of bone deformities was performed: osteotomy of the acromial process of the clavicle and middle third of the clavicle, which allowed for changing the plane of the acromioclavicular triangle and centralized the humeral head into a neutral position in the joint socket. In the second stage, muscle transposition and/or release surgeries were performed depending on the existing pathological changes.

The analysis of findings in the prospective group before and after surgery demonstrated an improvement in the upper limb function after performing stage-based surgical intervention. The surgery had a positive impact on both the muscle and bone components of the shoulder joint and scapula deformity, specifically in eliminating impingement syndrome and scapular lowering. However, based on CT imaging of the shoulder joint, in 2 cases of SHEAR deformation, there was a persistent torsion of the humeral bone (Fig. 4). This highlights the need for a more detailed diagnosis of pathological changes to refine the surgical intervention strategy. Specifically, for patients with congenital brachial plexus paralysis who are in the late stage of shoulder dysplasia, which prevents the release of soft tissues and tendon repositioning, it would be reasonable to add corrective derotational osteotomy of the humeral bone to the surgical strategy, the effectiveness of which has been demonstrated in similar cases by other researchers [20].

After treatment, functional improvement of the affected limb in the long-term post-operative period (2–4 years) was observed in 10 (62.5 %) patients of the prospective group. In 2 (12.5 %) cases, there was an increase in functional capacity of the affected limb from Mallet II to Mallet IV, in 2 (12.5 %) others from Mallet II to Mallet III, and in 6 (37.5 %) cases from Mallet III to Mallet IV.

After treatment, upper limb function remained unchanged, at Mallet IV level in 1 (6.2 %), Mallet III in 5 (31.3 %) patients. The most significant and statistically significant positive changes in the functional state of the upper limb in the long-term post-operative period were observed among patients in Group II ($p < 0.05$) (Table 2).

However, the difference in the frequency of positive changes in the functional state of the affected limb using the Mallet scale between the prospective and retrospective groups was not statistically significant ($\phi^* = 1.238$, $p = 0.1079$). This proves that the tactics and methods of treatment in both groups were correctly chosen and

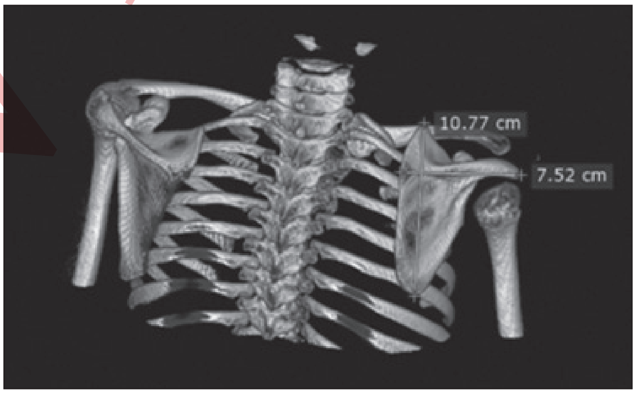

Fig. 3. CT scan of a patient with EOP. Measurement of SHEAR deformity (patient O., 9 years old): SHEAR deformity I (2.5 % of scapular standing above the clavicle in the frontal plane of CT).

Fig. 4. Postoperative CT scan of the shoulder joint of a 10-year-old patient S. with EOP, showing torsion of the humeral bone.

effective, despite literature indicating a high percentage of short-term effectiveness and recurrence after surgeries using the L'Episcopo method [21, 22].

During the MRC scale muscle strength assessment in the long-term post-operative period, it was found that the muscle strength increased in all patients of the prospective group by an average of (4.5 ± 1.9) points ($p < 0.001$). The differences between Group I and Group II were not statistically significant ($p > 0.05$) (Table 3). Considering that Group I patients had greater upper limb muscle strength before treatment compared to Group II ($p < 0.01$), the post-operative results indicate that the choice of surgical tactics and methods was correct, taking into account the identified pathological changes.

The quality of life of patients in the prospective group before and after treatment demonstrated a significant improvement in the functional status of the upper limbs and the ability of patients to perform daily activities, their psychological well-being, and life satisfaction.

Before treatment, parents of patients in the prospective group assessed the upper limb function using the DSQ questionnaire with an average score of (6.4 ± 1.8) points, and life satisfaction was 7.3 ± 2.4. The overall quality of life score was (13.6 ± 4.1) points ($p < 0.001$). After treatment, the functional status of the affected child improved by an average of (5.1 ± 1.3) points, life satisfaction increased by 4.3 ± 1.3 points, and the overall quality of life score improved by 9.4 ± 2.6 points ($p < 0.001$). There was no statistically significant difference in the functional status and satisfaction scores between Groups I and II before treatment ($p > 0.05$). However, after treatment, a statistically significant difference was found in the improvement of psychological well-being and life satisfaction, and thus overall quality of life improved more among patients in Group II compared to Group I ($p \le 0.05$) (Table 4).

The life satisfaction score in Group I increased by an average of (3.4 ± 0.7) points, while in Group II it increased by 5.6 ± 0.9, with the statistical significance of the difference being $p < 0.001$. The overall quality of life score in Group I increased by an average of 8.0 ± 1.1, while in Group II it increased by (11.4 ± 2.3) points, with the statistical significance of the difference being $p < 0.05$ (Table 5). Considering the significantly worse objective functional state indicators of the affected limb in Group II patients before treatment and the dynamics of positive changes in the long-term post-operative period according to the diagnostic data, it can be concluded that the intervention was effective due to the correct choice of tactics and methods based on the severity

Table 2

Dynamics of functional status evaluation of the upper limb using the Mallet scale after surgical treatment in patients of the prospective group

Indicator	Prospective group, total number of patients, (%)	Group I, number of patients, (%)	Group II, number of patients, (%)
Improvement in the function of the affected limb, total, including an increase in the grading level:	10 (62.5 %)	3 (37.5 %)	7 (87.5 %)
– From Mallet II to Mallet III;	2 (12.5 %)	1 (12.5 %)	1 (12.5 %)
– From Mallet II to Mallet IV;	2 (12.5 %)	—	2 (25.0 %)
– From Mallet III to Mallet IV	6 (37.5 %)	2 (25.0 %)	4 (50.0 %)
Functional state of the affected limb without changes:	6 (37.5 %)	5 (62.5 %)	1 (12.5 %)
– Mallet III;	5 (31.3 %)	1 (12.5 %)	1 (12.5 %)
– Mallet IV	1 (6.2 %)	4 (50.0 %)	—
Fisher's exact test (□*), p-value	—	φ* = 2.201, p = 0.0139	

Table 3

Average muscle strength scores after treatment among patients in the prospective group according to the MRC scale (in points)

Indicator	Subgroup	Score	Comparison of mean values, p-value
Muscle strength after treatment	I	23.1 ± 1.4	$p > 0.05$
	II	21.3 ± 1.0	
Increase in muscle strength after treatment	I	3.6 ± 1.9	$p > 0.05$
	II	5.4 ± 1.3	

Notes. Results are presented as (M ± SD); where M is the mean value of the indicator in the group, and SD is the standard deviation.

Table 4

Average quality of life scores before and after treatment for patients in Subgroup I and Subgroup II of the prospective group based on parent surveys using the DSQ questionnaire (in points)

Scale	Subgroup	Period of observation	Score	p-value		
Upper limb functionality	I	before treatment	6.4 ± 1.4	$p^1 < 0{,}001$	$p^2 = 1.000$	$p^3 = 0.140$
		after treatment	10.9 ± 1.6			
	II	before treatment	6.4 ± 1.4			
		after treatment	12.1 ± 1.6			
Life satisfaction	I	before treatment	7.3 ± 41.5		$p^2 = 0.615$	$p^3 = 0.051$
		after treatment	10.6 ± 0.9			
	II	before treatment	6.8 ± 2.3			
		after treatment	12.4 ± 2.1			
Overall score	I	before treatment	13.6 ± 2.8		$p^2 = 0.794$	$p^3 = 0.001$
		after treatment	21.6 ± 2.3			
	II	before treatment	13.1 ± 4.4			
		after treatment	24.5 ± 3.4			

Notes. The results are presented as (M ± SD), where M is the mean value of the indicator in the group, SD is the standard deviation; p^1 — comparison of the mean values before and after treatment; p^2 — comparison of the results before treatment in both subgroups; p^3 — comparison of the results after treatment in both subgroups.

Table 5

Increase in quality of life indicators after treatment in patients of Subgroups I and II of the prospective group, based on parent surveys using the DSQ questionnaire (in points)

Score	Increase in the indicator after treatment	
	Subgroup I	Subgroup II
Function	↑ 4.5 ± 0.5	↑ 5.8 ± 1.7
p-value	p = 0.0632	
Life satisfaction	↑ 3.4 ± 0.7	↑ 5.6 ± 0.9
p-value	p = 0.0001	
Overall	↑ 8.0 ± 1.1	↑ 11.4 ± 2.3
p-value	p = 0.0019	

Notes. The results are presented as (M ± SD), where M is the mean value of the indicator in the group, SD is the standard deviation; p is the comparison of the mean values between the two groups, ↑ — increase.

of the identified pathological changes in Groups I and II. The lack of statistically significant difference in the assessment of the limb's functional state by the parents of the patients after treatment can be explained by the subjectivity of their evaluation.

The obtained data are consistent with other studies [2, 5, 7, 8] and highlight the importance of timely and high-quality diagnosis of pathological changes, as well as the choice of tactics and treatment methods depending on the severity of the damage.

Conclusions

The results of the study indicate that the accuracy of diagnosis using modern technologies and the rational choice of surgical methods, taking into account the degree of neurological disorders and the nature of pathological bone changes and deformities, are key factors in the effective treatment of patients with persistent upper limb function disorders due to Duchenne-Erb obstetric paralysis.

The data confirm that a differentiated approach to determining the treatment strategy allows for obtaining high-quality results in improving the functional capability of the affected limb and significantly improving quality of life indicators, including psychological and emotional well-being.

Conflict of Interest. The authors declare no conflicts of interest.

Prospects for Further Research. In the future, the development and implementation of a standardized diagnostic algorithm and treatment protocol for patients with the consequences of Duchenne-Erb obstetric paralysis are of interest.

Information on Funding. No benefits in any form were or will be received from any commercial side directly or indirectly associated with the subject of this article.

Authors' Contributions. Grytsenko A. M. — Concept and design, data collection and processing, drafting the article; Khmyzov S. O. — Data analysis, text editing; Shevchenko O. H. — Statistical analysis, drafting the article; Harbuznyak I. M. — Clinical material collection, conducting surgical interventions, data analysis; Yermak T. A. — Clinical material collection; Zlatnyk R. V. — Radiological studies.

References

1. Chung, K. C., Lynda, J.-S., & McGillicuddy, J. E. (Eds.). (2012). Practical management of pediatric and adult brachial plexus palsies. Elsevier
2. Shah, V., Coroneos, C. J., & Ng, E. (2021). The evaluation and management of neonatal brachial plexus palsy. *Paediatrics & child health, 26*(8), 493–497. https://doi.org/10.1093/pch/pxab083
3. Pondaag, W., & Malessy, M. J. (2020). Evidence that nerve surgery improves functional outcome for obstetric brachial plexus injury. *Journal of hand surgery (European Volume), 46*(3), 229–236. https://doi.org/10.1177/1753193420934676
4. Eckstein, K. L., Allgier, A., Evanson, N. K., & Paulson, A. (2020). Brachial plexus birth injuries and the association between pre-procedure and post-procedure pediatric outcomes data collection instrument scores and Narakas classification. *Journal of pediatric rehabilitation medicine, 13*(1), 47–55. https://doi.org/10.3233/PRM-190603
5. Arrigoni, C., Facchi, R., & Catena, N. (2025). The role of glenoid osteotomy in the treatment of shoulder dysplasia in brachial plexus birth palsy: A systematic review. *Journal of clinical medicine, 14*(16), 5610. https://doi.org/10.3390/jcm14165610
6. Basit, H., Ali, C. D. M., & Madhani, N. B. (2023). Erb palsy. In StatPearls. StatPearls Publishing
7. Li, H., Chen, J., Wang, J., Zhang, T., & Chen, Z. (2023). Review of rehabilitation protocols for brachial plexus injury. *Frontiers in neurology*, 14, 1084223. https://doi.org/10.3389/fneur.2023.1084223
8. Komar, T., Koval, O., & Khmara, T. (2024). Morphological prerequisites of origin upper, middle, and lower syndromes of injury of the primary bundles of the brachial plexus. *Clinical anatomy and operative surgery, 23*(2), 108–113. https://doi.org/10.24061/1727-0847.23.2.2024.37
9. Strafun, S. S., Borzikh, O. V., Naumenko, L. Yu., & Ipatov, A. V. (2011). Obstetric paralysis. In L. Yu. Naumenko (Ed.), Medical and social examination and rehabilitation in pathology of the musculoskeletal system. Porogy
10. Khmyzov, S., Hrytsenko, A., Kykosh, G., & Hrytsenko, A. (2023). Birth injury, Duchenne-Erb's obstetric palsy: Diagnosis and treatment (literature review). *Orthopaedics, traumatology and prosthetics,* (3), 69–78. https://doi.org/10.15674/0030-59872023369-78
11. Umut, G. U., Hoşbay, Z., Tanrıverdi, M., Yılmaz, G. G., Altaş, O., Korucu, A., & Aydın, A. (2024). Obstetric brachial plexus palsy and functional implications. *Medicina, 60*(11), 1850. https://doi.org/10.3390/medicina60111850
12. Hafner, P., Manzur, A., Smith, R., Jaiser, S., Schutz, P., Sewry, C., Muntoni, F., & Pitt, M. (2019). Electromyography and muscle biopsy in paediatric neuromuscular disorders. *Neuromuscular disorders, 29*(1), 14–20. https://doi.org/10.1016/j.nmd.2018.10.003
13. Conde, R. M., Pena, L. A. P., Elias, A. H. N., Guerreiro, C. T., Pereira, D. A., Sobreira, C. F. R., Marques Jr, W., & Barreira, A. A. (2023). Inter-rater reliability of the Rasch-modified MRC scoring criteria. *Journal of the peripheral nervous system, 28*(1), 119–124. https://doi.org/10.1111/jns.12534
14. Peters, M., & Crocker, H. (2023). Disease-Specific Questionnaire. In Encyclopedia of Quality of Life and Well-Being Research. Springer. https://doi.org/10.1007/978-3-031-17299-1_756
15. Thamer, S., Kijak, N., Toraih, E., Thabet, A. M., & Abdelgawad, A. (2023). Tendon transfers to restore shoulder function for obstetrical brachial plexus palsy. *JBJS Reviews, 11*(1). https://doi.org/10.2106/JBJS.RVW.22.00165
16. Berényi, M., Szeredai, M., & Cseh, Á. (2022). Neonatal brachial plexus palsy — Early diagnosis and treatment. *Ideggyógyászati szemle, 75*(7–8), 247–252. https://doi.org/10.18071/isz.75.0247
17. Rudoy, A., & Tereshchenko, M. (2021). Efficiency estimation of monitoring radiation doses during CT. *Bulletin of Kyiv polytechnic institute. instrument making, 61*(1), 85–90. https://doi.org/10.20535/1970.61(1).2021.237111
18. Wiertel-Krawczuk, A., Szymankiewicz-Szukała, A., & Huber, J. (2024). Brachial plexus injury influences efferent transmission. *Biomedicines, 12*(7), 1401. https://doi.org/10.3390/biomedicines12071401
19. Cebula, A., Cebula, M., & Kopyta, I. (2021). Muscle ultrasonographic elastography in children. *Children, 8*(11), 1042. https://doi.org/10.3390/children8111042
20. Azer, A., Mendiratta, D., Saad, A., Duan, Y., Cedarstrand, M., Chinta, S., Hanna, A., Shinora, D., McGrath, A., & Chu, A. (2023). Outcomes of humeral osteotomies versus soft-tissue procedures. *Frontiers in surgery*, 10, 1267064. https://doi.org/10.3389/fsurg.2023.1267064
21. Boileau, P., Baba, M., McClelland, W. B. Jr., Thélu, C.-É., Trojani, C., & Bronsard, N. (2018). Isolated loss of active external rotation. *Journal of shoulder and elbow surgery, 27*(3), 499–509. https://doi.org/10.1016/j.jse.2017.07.008
22. Bonnevialle, N., Elia, F., Thomas, J., Martinel, V., & Mansat, P. (2021). Osteolysis at the insertion of L'Episcopo tendon transfer. *Orthopaedics & traumatology: surgery & research, 107*(4), 102917. https://doi.org/10.1016/j.otsr.2021.102917

The article has been sent to the editors	Received after review	Accepted for printing
02.10.2025	09.11.2025	15.11.2025

ANALYSIS OF THE RESULTS OF SURGICAL TREATMENT OF PATIENTS WITH THE CONSEQUENCES OF OBSTETRIC DUCHENNE-ERB PARALYSIS

A. M. Hrytsenko, S. O. Khmyzov, O. G. Shevchenko, I. M. Harbuzniak, T. A. Yermak, R. V. Zlatnik

Sytenko Institute of Spine and Joint Pathology National Academy of Medical Sciences of Ukraine, Kharkiv

✉ Anastasiia Hrytsenko, MD: hrytsenkosurgery@gmail.com
✉ Sergii Khmyzov, MD, Prof.: s.khmyzov@gmail.com
✉ Olena Shevchenko: elena.shevch59@gmail.com
✉ Iryna Harbuzniak, MD, PhD: harbuzniak@gmail.com
✉ Tatiana Yermak, MD: yermaktatiana@gmail.com
✉ Ruslan Zlatnik, MD: ruslan.zlatnik@gmail.com