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## Comparative analysis of the treatment of patients with dysplastic and idiopathic osteoarthritis of the hip joint

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*Hip arthroplasty is a reliable and quick way to relieve the patient of pain, restore movement in the hip joint and improve the function of the affected limb, but the question of how effective this intervention is in dysplastic or idiopathic coxarthrosis requires further study. The objective of the study was to evaluate the effectiveness of treatment of patients with idiopathic and dysplastic coxarthrosis, and the effect of endoprosthesis on the work of the pelvic muscles. Methods. A comparative analysis of the treatment of 121 patients was conducted, which were divided into two groups — with dysplastic coxarthrosis (63 patients) and with idiopathic coxarthrosis (58 patients). The functional results of the treatment were studied according to the Harris scale, the data of stabilographic studies and the evaluation of the work of the muscles of the pelvic girdle, which are responsible for maintaining the horizontal balance of the pelvis. Results. In general, the results of endoprosthesis were evaluated as good in both groups. At the same time, the average results in the group of patients with idiopathic coxarthrosis are significantly better ( $t = 2.08$ ;  $p = 0.001$ ) than in the group of patients with dysplastic coxarthrosis. However, the indicators of the muscles that ensure the horizontal balance of the pelvis, in most cases, remain reduced within 6–8 months after the endoprosthesis operation. This is evidenced by clinical data and statistical research data. Conclusions. Endoprosthesis of the hip joint is an effective method of coxarthrosis and allows to significantly improve both the patient's support and kinematic function and his quality of life. The results of treatment of patients with idiopathic coxarthrosis according to the Harris scoring scale are significantly better than the results of treatment of patients with dysplastic coxarthrosis. But the performance indicators of the muscles of the pelvic girdle, in most cases remain reduced within 6–8 months after endoprosthesis surgery in patients of both groups.*

*Ендопротезування кульшового суглоба — надійний і швидкий спосіб позбавлення пацієнта болю, відновлення рухів у кульшовому суглобі та покращення опороздатності ураженої кінцівки, але питання наскільки це втручання ефективно в разі диспластичного або ідіопатичного коксартрозу, потребує подальшого вивчення. Мета. Дослідити й оцінити ефективність лікування пацієнтів із ідіопатичним чи диспластичним коксартрозом, та вплив ендопротезування на роботу м'язів тазового пояса. Методи. Проведений порівняльний аналіз лікування 121 пацієнта, яких розподілено на дві групи — із диспластичним коксартрозом (63 хворих) та з ідіопатичним (58 осіб). Вивчено функціональні результати лікування за даними шкали Харріса, показниками стабілографічних досліджень та оцінювання роботи м'язів тазового пояса, відповідальних за утримання горизонтальної рівноваги таза. Результати. Здебільшого, наслідки ендопротезування оцінено як хороші в обох групах. Водночас середні показники в групі пацієнтів із ідіопатичним коксартрозом достовірно кращі ( $t = 2,076$ ;  $p = 0,001$ ), ніж у групі з диспластичним. Але показники роботи м'язів, які забезпечують горизонтальну рівновагу таза, у більшості випадків лишаються зниженими в строки 6–8 місяців після операції ендопротезування. Про це свідчать клінічні показники і дані стабілографічних досліджень. Висновки. Ендопротезування кульшового суглоба є ефективним методом лікування коксартрозу і дозволяє значно покращити як опорно-кінематичну функцію пацієнта, так і якість його життя. Результати лікування хворих на ідіопатичний коксартроз за показниками бальної шкали Харріса достовірно кращі, ніж пацієнтів, хворих на диспластичний коксартроз. Але показники роботи м'язів тазового пояса, здебільшого, лишаються зниженими в строки 6–8 місяців після операції ендопротезування у хворих обох груп. Ключові слова. Ідіопатичний коксартроз, диспластичний коксартроз, ендопротезування, м'язи-стабілізатори таза.*

**Key words.** Idiopathic, dysplastic coxarthrosis, endoprosthesis, pelvic stabilizer muscles

## Introduction

Dysplastic coxarthrosis most often leads to disability, limits the patient's ability to self-care, reduces the level of daily activity, work capacity and quality of life, i. e. desocializes such patients. Moreover, all this happens at a young age, which creates social, medical and economic challenges both for the individual and for society [1–3]. The disease gradually progresses due to congenital defects of the connective tissue and underdevelopment of the hip joint. This pathological condition of the hip joint is characterized by pronounced deformations of the proximal part of the femur, femoral head and acetabulum, distortion of the relationship between the articular surfaces and muscle dysfunction, which in general leads to changes in the biomechanics of the joint. On average, dysplastic changes in the hip joint are observed in 16.5 % of all musculoskeletal disorders [4–6].

Surgical intervention in the case of coxarthrosis is currently a generally recognized standardized procedure, but the treatment of adult patients with a dysplastic form of this disease requires a special medical and social approach.

The consequences of endoprosthetic repair in patients with dysplastic and idiopathic coxarthrosis differ significantly. If the immediate results in both cases are little different, then the long-term results are worse in patients with dysplastic coxarthrosis, due to the greater frequency of revisions and slow recovery of the supporting and kinematic function of the lower limb. Patients with dysplastic coxarthrosis after endoprosthesis more often demonstrate lameness, use additional support, etc. Thus, according to the Danish register of endoprosthetic repair, the number of complications during the first 6 months after joint replacement in the case of dysplastic coxarthrosis, it is 1.9 times higher than in the case of primary coxarthrosis, and 2.8 times during complete dislocation [7], the risk of revision interventions is 1.5 and 2 times higher, respectively [8].

At the same time, there is an opposite point of view, according to which there are no significant differences in the results of endoprosthetic repair in patients with dysplastic or idiopathic coxarthrosis [9, 10]. The authors consider the age of the patient and the type of endoprosthesis to be more important factors affecting the treatment outcome. Such ambiguity of treatment results requires further research in this direction.

*Purpose:* to investigate and evaluate the effectiveness of treatment of patients with idiopathic and dysplastic coxarthrosis, and to find out the effect

of endoprosthetic repair on the work of the muscles of the pelvic girdle.

## Material and methods

The research materials were reviewed and approved by the committee on bioethics and deontology of the State Establishment “Professor M. I. Sytenko Institute of Spine and Joint Pathology of the National Academy of Sciences of Ukraine” (Protocol No. 244 of 29.04.2024)

The study involved assessment of the results of treatment of 121 subjects with diseases of the hip joint, who underwent total cementless hip joint replacement at the clinic of the State Establishment “Professor M. I. Sytenko Institute of Spine and Joint Pathology of the National Academy of Sciences of Ukraine” during 2012–2020. The patients were divided into two groups.

The first group consisted of 63 patients with dysplastic coxarthrosis with Crowe grade 1–3 hip dysplasia. The average age was ( $42 \pm 12$ ) years, from 29 to 75 years, men — 22 (34.9%), women, respectively, 41 (65.1 %). Inclusion criteria were: age — 29–75 years, hip dysplasia 1–3 degree according to Crowe.

The second group consisted of 58 individuals with stage III–IV idiopathic coxarthrosis. The average age of the patients in the group was ( $54 \pm 10$ ) years, from 35 to 75 years, 24 men (41.4 %), 34 women (58.6 %).

All patients underwent a clinical examination, which included history study, evaluation of presentation, a general clinical and orthopedic examination to determine the state of the hip joint and pelvic girdle, as well as additional radiological methods: radiography, computer or magnetic resonance imaging, if necessary. The study of the function of the locomotor system was performed according to the classical method of studying a traumatological patient [11].

The analysis of age data revealed the heterogeneity of the groups. In the first group, 90.5 % of patients were young and middle-aged (up to 60 years old), and the number of patients in the older age group was only 6. In the second group there were 17 (29.3 %) patients older than 60 years, which corresponds to the peculiarities of the development and course of coxarthrosis of various etiologies.

During the clinical assessment of the state of the support and kinematic function of the pelvis and lower limbs, the symmetry of standing and walking was investigated. The absence or presence of lameness, the use of additional means of movement, the signs of insufficiency of the stabilizer muscles of the hip joint, pelvis, and lumbar spine were investigated (in the case of a decrease in muscle mass,

in the presence of Duchenne, Trendelenburg symptoms, lameness, and additional support). The stability parameters were evaluated according to the stadiography indicators. Muscle strength was studied on a 5-point scale. To determine the results of the treatment, individual clinical indicators of the patients of the first and second groups were analyzed before the operation and the total result was calculated according to the Harris scale, then similar indicators and the total result after the endoprosthesis operation were studied in the interval from 6 to 8 months. This length of follow-up was chosen due to the possibility of examining the maximum number of patients in this standard time period for the study of immediate results. The second reason was that patients in the period of 6–8 months after the intervention already created new motor stereotypes, but they were still subject to correction. Third, by this time, most patients have already received at least one course of restorative treatment, and at this time the active formation and consolidation of new adaptive and compensatory mechanisms of the locomotor system was underway, allowing to study and influence them.

Based on the nominal nature of the data, the analysis was performed by the method of combined tables with the calculation of the Pearson consistency criterion  $\chi^2$  and the statistical significance of the criterion ( $p$ ). Hip function data were compared using the T-test for unpaired samples with the calculation of the critical value of the criterion ( $t$ ) and its significance ( $p$ ). The analysis was carried out in the IBM Statistics SPSS 20.0 package.

## Results

In all examined patients, the main reason for seeking help was significant pain in the area of the hip joint, restriction of movement and noticeable gait disturbances.

Less than a third of patients in both groups — 39 subjects (32.2 %) — during hospitalization noted weak or moderate pain in the hip joint, other patients complained of severe pain syndrome.

After hip joint replacement, the nature and intensity of the pain syndrome changed in both groups. In the first group of patients with dysplastic coxarthrosis, 9 patients (14.3 %) complained of intermittent, moderately severe pain, which they rated from 2 to 6 points. Among the patients of the second group with idiopathic coxarthrosis, there were 6 such persons, which was 10.3 %.

The results of evaluation of clinical indicators of disorders of locomotor function in the form of lameness, use of additional support while walk-

ing, symptoms of muscle insufficiency, limitation of movements and the presence of contracture in the hip joint in patients before and after treatment are shown in the Table.

More than a third of patients in the first (20 (31.8 %) and second (21 (36.2 %)) groups used additional means of transportation before the operation. After treatment, their number decreased statistically significantly ( $p < 0.001$ ) — in group I to 2 (3.2 %), in group II to 1 (1.7 %) patients.

Lameness was widespread among patients in the 1st group — 55 (87.3 %) individuals, in the 2<sup>nd</sup> group — 49 (84.5 %), which was statistically the same ( $p = 0.655$ ). Six months after hip arthroplasty, the number of people with lameness decreased significantly ( $p < 0.001$ ), but there were still enough patients with signs of lameness in group I — 35 (55.6 %) persons, in group II — 30 (51.7 %).

56 (88.9 %) patients of group I and 49 (84.5 %) of group II had pronounced flexion-adduction contracture of the hip joint, which led to projection lengthening of the opposite limb, pelvic tilt and hyperlordosis of varying degrees. There was no significant difference in the presence of this feature in the groups ( $p = 0.475$ ). After treatment, the final manifestations of contracture remained in 9 people.

Muscle hypotrophy was observed significantly ( $p = 0.003$ ) more often in patients of the I group — 61 (96.8 %) compared to the II — 46 (79.3 %). After treatment, the number of people with muscle hypertrophy decreased significantly ( $p = 0.005$ ) in the first group, but no significant decrease in this sign was recorded in the second group ( $p = 0.656$ ), 44 (75.9 %) patients had a significant decrease in muscle strength. Trendelenburg's symptom was noted in groups of patients with a frequency of almost 90 %, 6 months after endoprosthetic repair, the number of patients with this symptom decreased statistically significantly ( $p < 0.001$ ), but still remained at a fairly noticeable level, i.e., in group I, the symptom was noted in 33 (52.4 %) patients, and in group II in 35 (60, 3 %).

Duchenne symptom was observed in both groups in 75 % of cases on average ( $p = 0.794$ ), a significant ( $p < 0.001$ ) decrease in the number of patients with this disease was determined in group I to 52.4 % (48 subjects), in group II a significant decrease in the number of patients was not detected ( $p = 0.114$ ) — 35 (60.3 %) persons.

In our opinion, lameness and Duchenne symptom during walking were mostly observed due to the maintenance of a false motor stereotype and residual insufficiency of the muscles responsible for postural balance.

**Clinical signs of pelvic girdle muscle dysfunction responsible for postural balance before and after hip joint replacement**

Indicator	Observation period	Group I (n = 63)	Group II (n = 58)	Statistical significance of the difference between groups
Additional support	before treatment	20 (31.8 %)	21 (36.2 %)	$\chi^2 = 0.106$ p = 0.605
	after 6 months	2 (3.2 %)	1 (1.7 %)	$\chi^2 = 0.005$ p = 0.608
	statistical significance of the difference between periods	$\chi^2 = 15.915$ p < 0.001	$\chi^2 = 20.250$ p < 0.001	—
Lameness	before treatment	55 (87.3 %)	49 (84.5 %)	$\chi^2 = 0.034$ p = 0.655
	after 6 months	35 (55.6 %)	30 (51.7 %)	$\chi^2 = 0.057$ p = 0.673
	statistical significance of the difference between periods	$\chi^2 = 14.039$ p < 0.001	$\chi^2 = 12.858$ p < 0.001	—
Contracture	before treatment	56 (88.9 %)	49 (84.5 %)	$\chi^2 = 0.199$ p = 0.475
	after 6 months	6 (9.5 %)	3 (5.2 %)	$\chi^2 = 0.319$ p = 0.362
	statistical significance of the difference between periods	$\chi^2 = 76.244$ p < 0.001	$\chi^2 = 70.583$ p < 0.001	—
Muscle hypotrophy	before treatment	61 (96.8 %)	46 (79.3 %)	$\chi^2 = 7.424$ p = 0.003
	after 6 months	51 (82.5 %)	44 (75.9 %)	$\chi^2 = 0.211$ p = 0.496
	statistical significance of the difference between periods	$\chi^2 = 6.509$ p = 0.005	$\chi^2 = 0.050$ p = 0.656	—
Trendelenburg test	before treatment	57 (90.5 %)	52 (89.7 %)	$\chi^2 = 0.024$ p = 0.880
	after 6 months	33 (52.4 %)	35 (60.3 %)	$\chi^2 = 0.488$ p = 0.377
	statistical significance of the difference between periods	$\chi^2 = 20.572$ p < 0.001	$\chi^2 = 11.770$ p < 0.001	—
Duchenne test	before treatment	48 (76.2 %)	43 (74.1 %)	$\chi^2 = 0.003$ p = 0.794
	after 6 months	33 (52.4 %)	35 (60.3 %)	$\chi^2 = 0.488$ p = 0.377
	statistical significance of the difference between periods	$\chi^2 = 6.775$ p < 0.001	$\chi^2 = 1.918$ p = 0.114	—

Thus, we note that the greatest changes occurred in the indicators of stability and resistance of the hip joint, while the indicators of the efficiency of muscle work improved in a much smaller number of patients.

According to the data of statistical studies of patients of both groups conducted before the operation, asymmetry of the position of the projection of the displacement of the general center of mass (GCM) during the two-legged stance was revealed, with its shift towards the relatively healthy limb. The tilt of the pelvis due to the presence of a contracture was more pronounced in patients with dysplastic coxarthrosis and

caused a shift of the body towards the longer limb. The main sign of coxarthrosis is the standing of patients with increased sway in the sagittal plane, but in the later stages of the disease, the amplitude of sway increases in both the sagittal and frontal planes.

After the operation, the amplitude of oscillations of the GCM projection, and accordingly, the area of oscillations of the GCM projection decreases, however, these changes do not have significant differences between groups and observation periods. That is, 6 months after endoprosthesis surgery, patients tend to restore stability (postural balance), but not completely.

The range of active and passive movements in the hip joint was studied before and after surgery using a standard neutral zero-pass method, which allowed monitoring the dynamics of the recovery period and making corrections during the treatment process. The amount of flexion in the hip joint before surgery in almost all patients was less than 90° and ranged from 30° to 60°. After endoprosthetic repair, the amount of flexion in the operated joint was 90° or more in all patients of both groups.

The strength of the muscles of the lower extremities was evaluated clinically in points (on a generally accepted 5-point scale). 11 (17.5 %) people with dysplastic coxarthrosis and 13 (22.4 %) patients with idiopathic coxarthrosis demonstrated maximum hip flexor strength (5 points) during clinical assessment before surgery ( $p = 0.818$ ). Other patients showed a decrease in muscle strength up to 3–4 points. After the intervention, this indicator recovered rather slowly and we did not detect a noticeable increase in muscle strength in 6–8 months.

The functional results of surgical treatment were evaluated in patients of both groups according to the Harris method before surgery and 6–8 months after. To do this, the functional status of each patient in the group was determined, then the average value of the result in points and the value of the standard deviation in the studied group were calculated, after which the treatment indicators of the patients of both groups were compared. The indicators are shown in the diagram (Figure).

The functional state of the hip joint according to the Harris scale before the operation was on average ( $34.6 \pm 7.6$ ) points in patients of group I, in group II the state of the hip joint according to the Harris scale before the operation was ( $31.8 \pm 8.4$ ) points, statically

significant difference between groups was not determined ( $t = 2.41$ ;  $p = 0.018$ ).

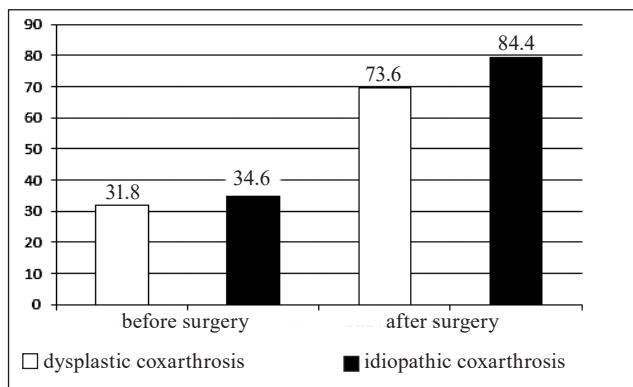
Within 6–8 months from the moment of endoprosthetic surgery, the average indicator of the functional state of the hip joint in patients of group I was equal to ( $84.4 \pm 9.4$ ) points, which was statistically significant ( $t = 4.71$ ;  $p < 0.001$ ) more than in patients of group II, in whose average score on the Harris scale was ( $73.6 \pm 11.6$ ). Such a difference in indicators shows that it is more difficult to achieve a good result in patients with dysplastic coxarthrosis.

Thus, comparing the clinical results of treatment of patients with dysplastic and idiopathic coxarthrosis, it can be stated that total hip arthroplasty reliably relieves most patients of pain, eliminates joint contracture, restores the bearing capacity of the limb, improves the patient's mobility and increases daily activity. But the indicators of muscle work, which ensure postural balance, mostly remain reduced in the period of 6–8 months after this operation. This is evidenced by both clinical data and indicators of statistical studies.

At the same time, the results of treatment of patients with idiopathic coxarthrosis are generally significantly better than in the case of dysplastic coxarthrosis. In our opinion, this is related to the peculiarities of the muscles in the case of dysplastic coxarthrosis and the conditions of their functioning. A very influential factor on the work of the muscles is a violation of the shape and structure of the acetabulum and the proximal part of the femur, as well as a change in the position of the center of rotation of the head of the femur, which change the moments of forces of the pelvic girdle, which, in our opinion, not only complicates the selection of components, but also the installation of an endoprosthesis makes the result of surgical intervention less predictable. The most optimal ratio of normal anatomy of the hip joint and sufficient muscle strength ensures the effective operation of the abduction mechanism of the hip joint. Considering the above, it can be assumed that the geometric parameters of the hip joint and their interrelationships should be considered as biomechanical conditions for the effective function of the muscles of the pelvic girdle, the change of which leads to muscle dysfunction.

### Discussion

More than 1.5 million endoprosthetic surgeries on the hip joint are performed annually in the world, and their number is increasing every year. The same trend is observed in Ukraine [13].



**Figure.** Indicators of the functional state of the hip joint of patients according to the Harris scale before and after endoprosthetic repair

The selection of endoprosthesis components is a very important stage of preoperative planning, which determines the quality, efficiency and longevity of the further functioning of the artificial hip joint. In the case of the initial stages of idiopathic coxarthrosis, this usually does not cause problems [14, 15].

But as for the non-geometric, but biomechanical parameters that are taken into account during the planning and execution of the operation in the case of dysplastic coxarthrosis, they often cannot be optimally balanced during the installation of the endoprosthesis due to the previous contracture of the joint, changes in the work of the muscles, the peculiarities of the long-term work of the joint in the conditions changed geometry of joint relations and bone structure of the pelvis, anteversion of the hip and other reasons [16].

It is shown in the literature that the tolerances of the endoprosthesis parameters, which occur in the case of endoprosthesis, are compensated during walking thanks to the work of the muscles [16, 17], the question remains as to how much it is possible to restore the work of the muscles in the postoperative period and to build new movement strategies that are optimal for new working conditions of the pelvic girdle with an artificial hip joint.

Our studies have shown that total hip arthroplasty for idiopathic or dysplastic coxarthrosis provides good short- and medium-term treatment results. But there is still a difference between these groups. If the supporting and motor function of the hip joint can be restored in both groups of patients, then such indicators as lameness, shorter duration of standing and walking, etc., are more noticeable in patients with dysplastic origin of coxarthrosis.

This indicates insufficient restoration of the function of the muscular apparatus of the pelvic girdle (in particular, the work of the abduction mechanism), which ensures horizontal balance of the pelvis, after the operation. This gives us reason to believe that patients with dysplastic coxarthrosis have a lower rehabilitation potential and a more difficult rehabilitation prognosis compared to patients with idiopathic coxarthrosis.

The study has certain limitations, for example, although we indicated the inclusion criteria of patients according to age and degree of dysplasia, we did not distinguish separate groups of patients according to the degree of dysplasia according to Crowe. In our opinion, this is not important from the point of view of our goals. In addition, we evaluated the results in terms of 6–8 months, and not in the generally accep-

ted 12 months, and this has a certain meaning for us, which we explained earlier.

## Conclusions

Endoprosthetic repair of the hip joint is an effective method of treating both dysplastic and idiopathic coxarthrosis, which allows to significantly improve both the patient's support and kinematic function and his quality of life. The most noticeable positive changes were the indicators of stability and resistance of the hip joint in patients of both groups. But in general, the results of treatment of patients with idiopathic coxarthrosis according to the Harris scoring scale are reliably better than the results of treatment of people with dysplastic coxarthrosis.

Performance indicators of the muscles of the pelvic girdle, which ensure postural balance, mostly remain low during the period of 6–8 months after surgery. They either improved in a significantly smaller number of patients or remained at the preoperative level.

**Conflict of interest.** The authors declare no conflict of interest.

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## COMPARATIVE ANALYSIS OF THE TREATMENT OF PATIENTS WITH DYSPLASTIC AND IDIOPATHIC OSTEOARTHRITIS OF THE HIP JOINT

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