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Анализ ранних результатов применения прямого переднего доступа с кожным разрезом «бикини» при первичном эндопротезировании тазобедренного сустава

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АННОТАЦИЯ

Обоснование. В настоящее время при реконструкции тазобедренного сустава всё шире используются менее инвазивные методы, что обусловило повышение интереса к прямому переднему доступу и способствовало значительному росту его распространения в течение двух последних десятилетий. С анатомической точки зрения применение прямого переднего доступа при эндопротезировании тазобедренного сустава ассоциировано с меньшей травматизацией мягких тканей.

Цель. Оценить результаты первичного эндопротезирования тазобедренного сустава путём использования прямого переднего доступа с кожным разрезом «бикини».

Материалы и методы. В исследование были включены 163 пациента с коксартрозом, в том числе 71 мужчина и 92 женщины, которые затем были рандомизированы в 2 группы: группу 1 (сравнения) — 78 пациентов, у которых применялся стандартный (боковой) доступ при выполнении первичного эндопротезирования тазобедренного сустава, и группу 2 (основная) — 85 пациентов, у которых при выполнении первичного эндопротезирования был использован прямой передний доступ. Для исследования эффективности предложенного подхода к эндопротезированию тазобедренного сустава использовали результаты динамической оценки жалоб (выраженность болевого синдрома) и функционального состояния поражённого сустава с помощью шкал Harris Hip Score и Western Ontario and McMaster Universities osteoarthritis Index WOMAC. При анализе безопасности хирургического лечения учитывали частоту послеоперационных осложнений.

Результаты. Всего в группе сравнения было отмечено 3 случая осложнений (3,9%), тогда как в основной группе количество осложнений в раннем послеоперационном периоде после эндопротезирования было ниже — 1 случай (1,2%). Оценка длительности стационарного лечения показала, что в группе сравнения значение этого показателя было равно 5–6 суткам, тогда как в основной группе оно было ниже, составляя 2–3 суток. Изучение динамики показателя оценки пациентами болевого синдрома по визуально-аналоговой шкале показало, что через сутки после операции значение показателя в группе 2 составило 7,94±0,41 балла и было статистически значимо ниже (p <0,05) соответствующего показателя в группе 1 — 8,21±0,39 балла.

Заключение. В послеоперационном периоде применение прямого переднего доступа при эндопротезировании тазобедренного сустава ассоциировано с меньшей выраженностью болевого синдрома, более быстрым восстановлением функциональности тазобедренного сустава и меньшей длительностью стационарного этапа лечения по сравнению с переднебоковым доступом.

Ключевые слова: эндопротезирование тазобедренного сустава; прямой передний доступ; коксартроз; болевой синдром; послеоперационный период; послеоперационные осложнения; малоинвазивный доступ.

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Analysis of the early results of using the direct anterior approach with a skin incision “bikini” in primary hip arthroplasty

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ABSTRACT

BACKGROUND: The use of less invasive techniques in hip arthroplasty is on the rise, which has led to an increased interest in direct anterior access and contributed to a significant expansion of its use over the past two decades. From an anatomical point of view, the use of direct anterior access in hip arthroplasty is associated with less soft tissue trauma.

AIM: To evaluate the results of primary hip arthroplasty using direct anterior access with a "bikini" skin incision.

MATERIAL AND METHODS: 163 patients with coxarthrosis were enrolled in the study, including 71 men and 92 women, who were then randomised into 2 groups: group 1 (comparison) — 78 patients in whom a standard (lateral) access was used for primary hip arthroplasty, and group 2 (main) — 85 patients in whom a direct anterior access was used for primary hip arthroplasty. To study the effectiveness of the proposed approach to hip arthroplasty, we used the results obtained by dynamic assessment of complaints (severity of pain syndrome) and functional status of the affected joint using Harris Hip Score and Western Ontario and McMaster Universities osteoarthritis Index WOMAC scales. When analysing the surgical treatment safety, the incidence of postoperative complications was taken into account.

RESULTS: In total, 3 cases of complications (3.9%) were noted in the comparison group, whereas in the main group the number of complications in the early postoperative period after endoprosthesis was lower — 1 case (1.2%). The assessment of inpatient treatment duration showed that in the comparison group the value of this index was equal to 5–6 days, whereas in the main group it was lower, being 2–3 days. Studying the dynamics of the pain syndrome assessment index by the patients according to the visual analogue scale showed that a day after the operation the index value in group 2 was 7.94±0.41 points which was statistically significantly lower (p <0.05) than the corresponding index in group 1 — 8.21±0.39 points.

CONCLUSION: In the postoperative period, the use of direct anterior access in hip arthroplasty is associated with a lower severity of pain syndrome, faster recovery of hip joint functionality, and shorter in-patient stay compared with anterolateral access.

Keywords: hip arthroplasty; direct anterior approach; coxarthrosis; pain syndrome; postoperative period; postoperative complications; minimally invasive approach.

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INTRODUCTION

Increased life expectancy in most countries has resulted in increased occurrence of degenerative musculoskeletal diseases, with osteoarthritis (OA) of large joints being the most prevalent [1–3]. According to Jin et al. (2020), the global incidence of OA increased annually by 0.32% (95% confidence interval (CI): 0.28%–0.36%) from 1990 to 2017, with an overall increase of 9% over 28 years. Considering the general trend of aging worldwide, the number of new OA cases may increase even more rapidly [4].

OA accounted for 24.2% of all cases of musculoskeletal disorders in Russian adults, according to the 2016 statistics from the N.N. Priorov National Medical Research Center for Traumatology and Orthopedics. Among people of working age, OA accounts for 15.2% of musculoskeletal diseases, whereas among those of retirement age, this figure reaches 33.7% [5]. Previous data indicate the importance of developing and improving treatment methods for OA in large joints, specifically the prevalent disease coxarthrosis.

Endoprosthesis is the primary surgical method for treating hip joint pathologies. It can provide a rapid rehabilitation effect and significantly improve patients' quality-of-life [6–9]. Total hip arthroplasty (HA) is generally performed using a direct lateral or posterior approach (PA). However, owing to the increasing demand for minimally invasive surgical techniques, other approaches, such as the direct anterior approach (DAA) for HA, have gained popularity in recent years [10–13].

Less-invasive techniques are increasingly being used in hip reconstruction, leading to a growing interest in DAA. Its prevalence has significantly increased over the past two decades. DDA was first described by Hueter in 1881 [14] and was developed by Smith-Petersen, who used this approach in hip surgery. His initial publication was dated 1917. In 1980, Light and Keggi reported extensive experience using this approach for performing HA [15].

From an anatomical perspective, the use of DDA in HA is associated with less soft tissue trauma and contributes to greater surgical convenience [2, 16–19]. Currently, the frequency of applying different approaches during primary HA is determined based on surgeons' preferences, medical institutions' traditions, and other factors. However, there is no convincing clinical evidence to prove the advantages or disadvantages of using different approaches.

Thus, this study aimed to assess the outcomes of primary HA using the DAA with a bikini incision technique.

MATERIALS AND METHODS

Study design

A prospective study was conducted on patients referred to a clinic for HA.

Eligibility criteria

Patients were initially selected according to the following inclusion criteria:

- Patients of both sexes aged 18–79 years
- Idiopathic coxarthrosis or dysplastic coxarthrosis of the first degree according to Crowe classification and stage II–III according to the N.S. Kosinskaya classification and aseptic necrosis of the femoral head
- Voluntary consent of the patient to participate in the study and readiness for adequate cooperation during the course of the study

The final selection of participants was performed by excluding those who met the following exclusion criteria:

- Previous surgical treatment of the hip joint
- Pronounced overgrowth of marginal osteophytes of the acetabulum, significantly limiting visualization of the surgical site, and femoral defects, such as destruction or absence of the femoral medullary canal, which prevent correct insertion of the femoral component of the endoprosthesis
- Osteomyelitis at the proposed surgical site (pelvic bones, head, and neck or femoral condyles in patients with coxarthrosis)
- Purulent arthritis of the affected joint within 6 months preceding the planned surgery
- Purulent soft tissue infection in the area of the affected joint within 3 months preceding surgery
- Scarring in the proposed surgical intervention site, involving the bony components of the affected joint
- Severe osteopenia
- Acute thrombophlebitis
- Immobilization of the patient, unrelated to a joint lesion, which prevents mobilization by endoprosthesis (due to hemiparesis resulting from stroke, neurodegenerative diseases, or other causes)
- Primary arthrodesis with satisfactory or relatively satisfactory functional outcome in the absence of pain syndrome
- Pregnancy and/or lactation
- Acute infectious-inflammatory diseases of any etiology or concomitant chronic infectious diseases in the active phase (e.g., tuberculosis, viral hepatitis, and HIV infection)
- Chronic inflammatory foci requiring sanitation, any localization
- Anemia of any degree and origin
- Erosive and ulcerative lesions of the gastrointestinal tract
- Grade 3 morbid obesity
- Severe concomitant somatic pathology with significant function impairment of the corresponding organs (uncontrolled arterial hypertension, decompensated diabetes mellitus, hemodynamically significant heart rhythm and conduction disorders, recent myocardial infarction or stroke, severe heart defects, acute and

chronic diseases of the lungs, liver and/or kidneys in the acute stage with the development of cardiac, respiratory, and hepatic and/or renal failure)
- Severe mental disorders or neurological diseases

Study settings

The study was conducted from 2019 to 2023 at the Traumatology and Orthopedics Departments of MEDSI Clinical Hospital No. 1 and Yusupov Hospital in Moscow, Russia.

Methods of target assessment

The outcomes of primary HA between patients with idiopathic coxarthrosis, dysplastic coxarthrosis, and aseptic necrosis of the femoral head using both standard lateral and DAA were compared.

A clinical examination showed the nature, severity, and conditions of pain syndrome in the affected joint. Furthermore, a dynamic assessment of pain using the standard visual analog scale (VAS) was performed from postoperative days 1 to 21.

The effectiveness of the proposed approach to HA was studied by analyzing the results of dynamic assessment of complaints (pain syndrome severity) and functional status of the affected joint using the Harris Hip Score and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scales.

The incidence of postoperative complications was considered when analyzing the safety of surgical treatment.

Patients in group 1 (comparison group) underwent total primary HA using the standard Hardinge lateral approach [20].

Patients in group 2 underwent intervention using DDA with the bikini incision technique. This method minimizes damage to the posterior capsule and external rotators, reducing the risk of joint instability, and preserves the tendon and muscle of the thigh broad fascia, which stabilize the lower limb during dynamic step loading while walking. Furthermore, the attachment sites of the small and middle gluteal muscles are preserved. This approach enables visualization of all anatomical structures relevant to the surgeon during surgery, facilitating accurate positioning of the endoprosthesis components.

The use of DDA in HA allows surgery to be performed on any standard orthopedic table without significant limitations (Fig. 1). Thus, in inferior and superior capsulotomy of the hip joint in "position no. 4," external rotation is conducted and the operated limb is brought under the contralateral limb. This approach enables surgery without the need for a specialized orthopedic table and avoids the need for hip hyperextension. After medial and lateral capsulotomy, a retractor is used to translate the hip into the surgical wound.

The optimal and safe position of the patient during DDA is the supine position. This position allows the surgeon to measure and adjust the length of the lower extremities individually for each patient as planned during preoperative preparation.

The patient was positioned supine on a standard surgical table with the legs draped loosely (Fig. 2). A skin incision was made in the pubic area, three fingerbreadths distal to the anterior superior iliac spine, with 2/3 of the incision lateral and 1/3 medial to the spine (Fig. 3). The tensegrity of the broad fascia in the abdomen was identified and incised (Fig. 4 and 5). After opening the space between the tensor of the broad fascia and rectus muscle, the lateral circumflex artery was coagulated.

The surgical procedure began with anterior capsulotomy and head extraction (neck fillet and head removal) (Fig. 6–8), followed by inferior and superior capsulotomy. To perform inferior capsulotomy (or pubofemoral ligament release), the patient's contralateral limb was placed over the contralateral limb to allow for slight external rotation. This allowed for surgical intervention of the small acetabulum and pubic–femoral ligament. For upper capsulotomy, the leg is positioned neutrally, and the bone hook is attached to the dense posteromedial region of the femur below the fibula (calcar femorale). This allows the femur to be pulled laterally and anteriorly, enabling the operating surgeon to clearly define the moment of release completion.

After capsular release, visualization of the acetabulum was simplified (Fig. 9). The femur is displaced posteriorly using a posterior retractor, which exposes the transverse acetabular ligament. Expansion can be initiated using either conventional or offset reamers (Fig. 10).

The femur is exposed by pulling on the bone hook in the anterior and lateral directions. This allows the soft tissue to be retracted using the femoral retractor. The retractor is placed at the level of the capsular release and provides an elevated position of the proximal femur. The leg is not extended but is placed under the opposite leg in a reduced position with slight external rotation (Fig. 4). A second retractor is used to expose the posteromedial aspect of the femur. The formation of the femoral component bed using rasps and the subsequent endoprosthetic steps are performed in the same manner as in the anterolateral approach [20] (Fig. 11–14).

During the surgical procedures, the authors used an optical image converter (OIC) to accurately position the acetabular component. The use of OIC for intraoperative correction of component placement decreases as surgical experience increases (>50 operations per year according to the learning curve).

The authors recommend using Müller-type femoral components for endoprosthesis placement and selecting the head diameter based on acetabular socket size. The recommended diameters are 28, 32, and 36 mm. The authors frequently use a head diameter of 32 mm.

In a prospective study, the only complication observed with DDA using a bikini incision was injury to the lateral cutaneous nerve of the thigh. Neuropathy of this nerve resolved spontaneously 2 months after surgery. We did

Fig. 1. Patient positioning.

Fig. 2. Operating field preparation.

Fig. 3. Projection of the skin incision "bikini".

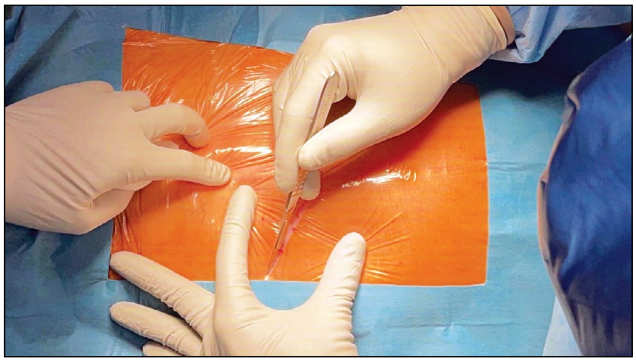

Fig. 4.1. Making an incision.

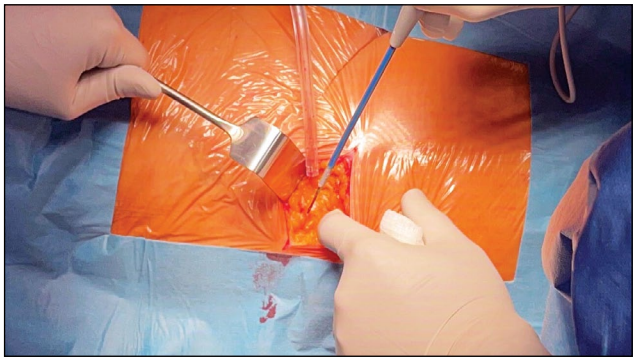

Fig. 4.2. Coagulation of the vessels of the subcutaneous fat.

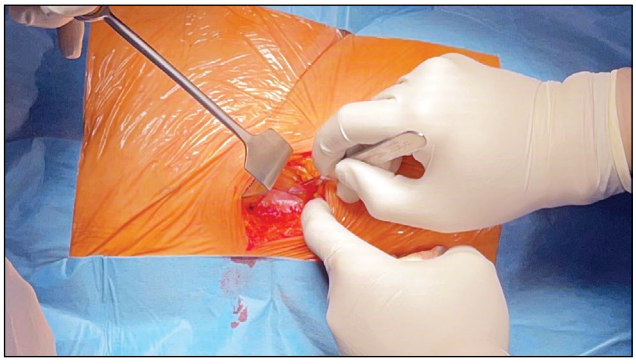

Fig. 5. Opening the fascia of the musculus tensor fasciae latae.

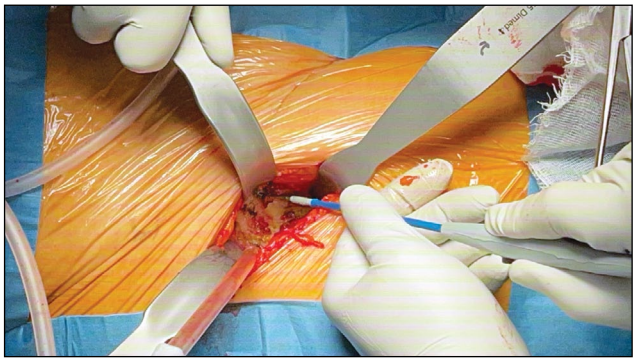

Fig. 6. Capsulotomy.

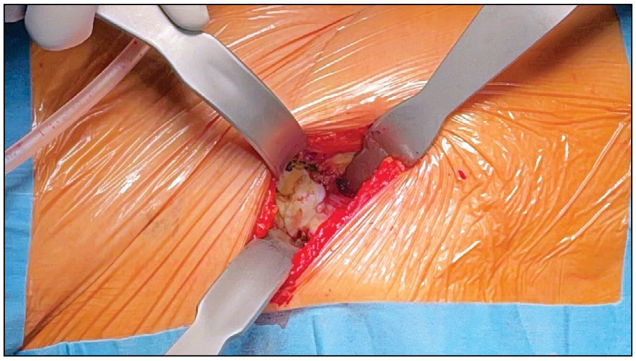

Fig. 7. Visualization of the neck of the left femur and preparation for osteotomy.

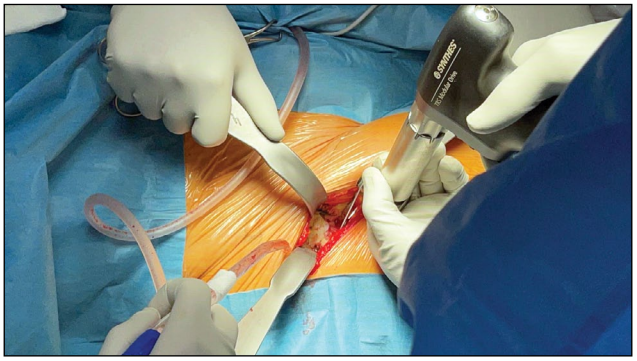

Fig. 8. Osteotomy of the femoral head.

Fig. 9. Visualization of the acetabular cavity before treatment.

Fig. 10.1. Treatment of the acetabulum.

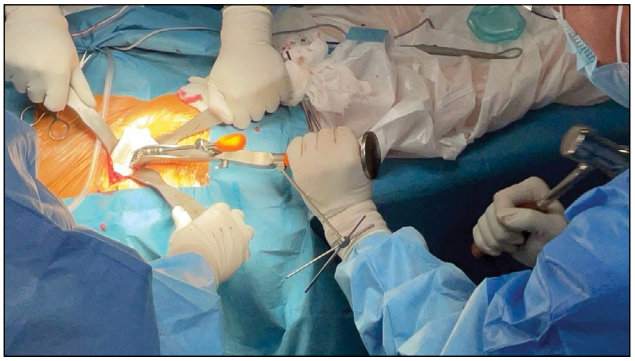

Fig. 10.2. Installation of the acetabular component.

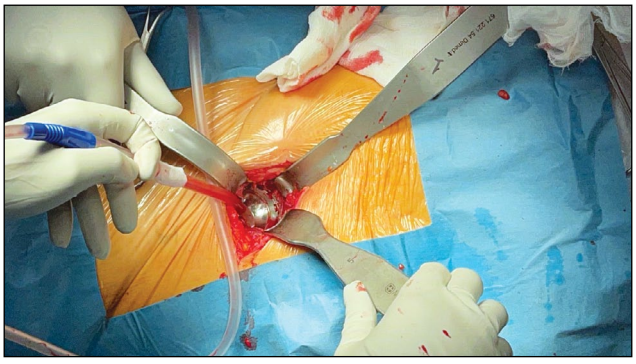

Fig. 10.3. Acetabular component set.

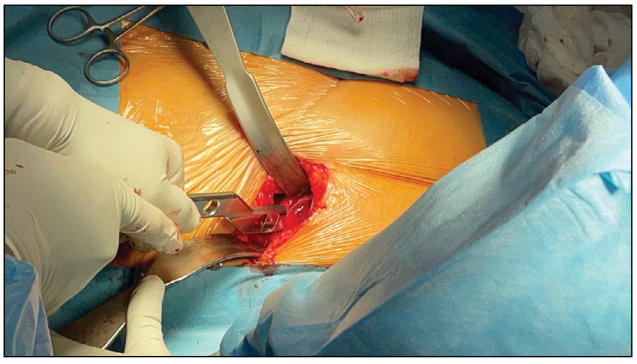

Fig. 11. Formation of the bone channel.

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Fig. 12. Insertion of the femoral component.

Fig. 13. Limb length check.

Fig. 14. Postoperative suture.

not observe this complication when using DDA with a perpendicular skin incision (caudal–cranial).

Ethical review

All manipulations performed in research involving human subjects were conducted in accordance with the standards of the local ethics committee and the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Formal consent from the local ethical committee was not required for this type of research.

Statistical analysis

The study results were analyzed using the StatSoft Statistica 10 and Microsoft Excel 2016 software packages. Mean values with standard errors of the mean were calculated, whereas qualitative parameters were presented as frequencies of occurrence of features as a percentage of the total number of patients in the respective groups.

Intergroup comparisons of quantitative indicators were conducted using the Mann–Whitney rank nonparametric test in cases of nonparametric distribution of indicator values and/or significant differences in dispersions between groups. Differences in qualitative parameters were analyzed using the chi-square or Fisher's exact test. Significance was determined at a p-value below the null hypothesis statistical significance level (alpha) of 0.05.

RESULTS

Participants

The study included 163 patients (men, 71; women, 92) with coxarthrosis who were randomized into two groups:

- Group 1 (comparison group): 78 patients who underwent primary HA using the standard (lateral) approach
- Group 2 (main group): 85 patients who underwent primary endoprosthetic replacement using DDA

All the study patients underwent a thorough preoperative examination. The primary method of treatment was endoprosthesis of the affected joint. After surgery, patients were followed up for 12 months to assess joint function, clinical parameters, complications, and outcomes.

The distribution of patients based on the OA stage, according to the N.S. Kosinskaya classification, was similar in both the main and control groups. Stage 3 OA was prevalent in both groups, diagnosed in 29 patients (60.4%) in group 1 and 33 (58.9%) in group 2. Stage 2 OA was less frequent in both groups, with 15 patients (31.3%) in group 1 and 17 (30.4%) in group 2. Surgical intervention was the least frequent in cases of stage 1 OA with severe pain syndrome. This was confirmed in four patients (8.3%) in the comparison group and in six patients (10.7%) in the main group. No statistically significant differences were noted between the groups in the frequency of different OA stages (p >0.05 for all comparisons).

The average age of patients in the main and comparison groups was 64.2±9.3 years and 66.5±10.2 years, respectively. The sex and age composition of patients with coxarthrosis was comparable in both study groups (p >0.05).

Main results of the study

Analysis of the incidence of complications in the early postoperative period after HA revealed that infectious complications were observed in one patient (1.3%) in group 1,

Table 1. The frequency of complications in the early postoperative period after hip arthroplasty using various approaches

Complications	Group 1 (comparison group), *n*=78		Group 2 (main group), *n*=85	
	n	%	*n*	%
Infectious-inflammatory process (ligature fistula)	1	1,3	–	–
Damage to the lateral cutaneous nerve of the thigh	–	–	1	1,2
Damage to the medial gluteal nerve	2	2,6	–	–
Total	3	3,9	1	1,2

whereas no such complications were observed in group 2 (Table 1). In group 1, two cases (2.6%) of upper gluteal nerve injury occurred, whereas in group 2, one patient (1.2%) experienced neuropathy of the lateral cutaneous nerve of the thigh.

In the comparison group, there were three cases (3.9%) of complications. However, in the main group, only one case (1.2%) of complications was observed during the early postoperative period after HA.

The assessment of hospitalization duration revealed that in the comparison group, the indicator value was 5–6 days, whereas in the main group, it was to 2–3 days. This difference in hospital stay duration was due to a shorter postoperative rehabilitation time, reduced need for opioid analgesia associated with a decrease in pain severity, and accelerated resumption of self-care.

This study analyzed the dynamics of the index of patients' pain syndrome assessment by VAS. The results showed that a day after surgery, the index value in group 2 was 7.94±0.41 points, which was significantly lower (p <0.05) than that in group 1, which was 8.21±0.39 points (Fig. 15).

On postoperative days 3 and 7, both groups showed a further decrease in the VAS pain score. However, the main group had statistically significantly lower levels of this parameter (p <0.05) than the comparison group.

Subsequently, the trend persisted. After 14 and 21 days, the index value in group 2 was 2.57±0.31 and 2.07±0.23 points, respectively. These values were significantly lower (p <0.05) than those in group 1, which were 4.89±0.62 and 3.24±0.53 points, respectively.

The present study evaluated the dynamics of the pain index according to the WOMAC scale in patient groups who underwent HA using different approaches. Before surgery, the pain index values were similar between the study groups (range: 27.7–28.3 points) (Table 2). After 1 month, the pain index value in the main group decreased to 19.8±2.0 points, which was significantly lower (p <0.05) than the comparison group's value of 25.2±2.9 points.

After 3 months, the pain index value decreased in both groups. The correlations remained the same: the main group had a significantly lower index value (p <0.05) than the comparison group. However, after 6 months, the index level did not differ between the patient groups, regardless of the surgical approach used during HA, according to the WOMAC scale.

One year after surgery, the value of this parameter decreased to 13.2±1.4 and 11.8±0.9 points in groups 1 and 2,

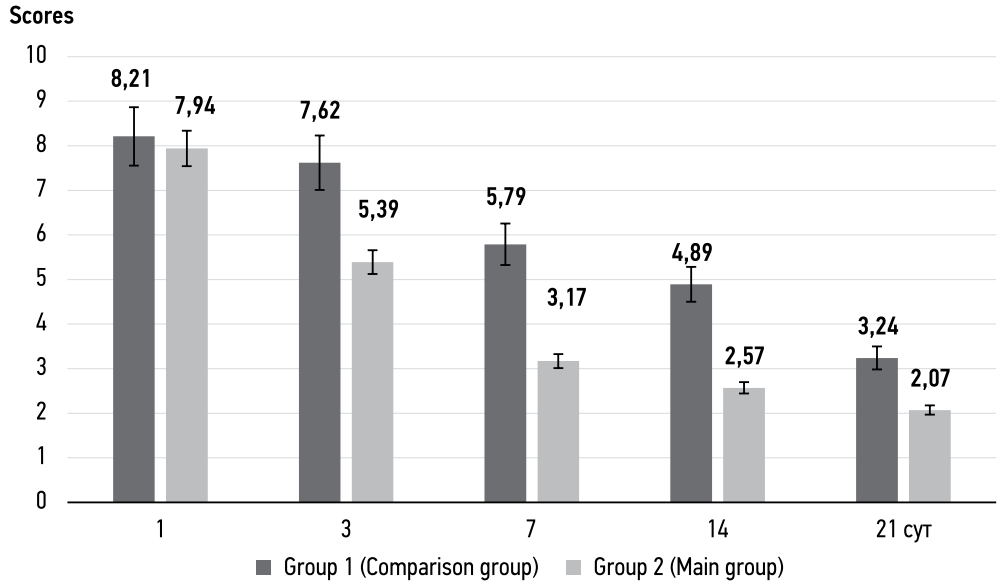

Fig. 15. Dynamics of patients' subjective assessment of pain syndrome according to the visual analogue scale after hip arthroplasty using various approaches.

Table 2. Dynamics of pain assessment according to the WOMAC scale, points (*M±m*)

Study period	Group 1 (comparison group), *n*=78	Group 2 (main group), *n*=85
Before surgery	28,3±2,6	27,7±2,1
After 1 month	25,2±2,9	19,8±2,0*
After 3 months	22,1±1,7	17,5±2,2*
After 6 months	18,3±2,0	16,6±1,9
After 12 months	13,2±1,4	11,8±0,9

*Note (here and in Table 3–5). * —* statistically significant intergroup differences (p <0.05) when compared with the corresponding indicator of group 1 (Mann–Whitney test), WOMAC — Western Ontario and McMaster University Osteoarthritis Index.

respectively. However, the revealed differences did not reach statistical significance (p=0.062).

Analysis of the dynamics of the WOMAC stiffness score showed a significant decrease in both groups during the follow-up period. After 1 month, the value of this parameter in the main group was 66.5±7.3 points, which was statistically significantly lower (p <0.05) than that in the comparison group, which was 83.9±6.5 points (Table 3).

After 3 months, the correlation remained unchanged: the index value in the main group was significantly lower than that in the comparison group. At 6 months and 1 year later, the WOMAC values in the main group were slightly lower than those in the comparison group; however, the difference was not statistically significant (p >0.05), regardless of the surgical approach used for HA.

This study analyzed functional activity limitation using the WOMAC scale. Before surgery, the index values did not differ between the study groups (range: 6.93–7.31 points) (Table 4). One month after HA, the main group's index level decreased to 5.89±0.74 points, which was significantly lower (p <0.05) than that in the comparison group (6.68±0.63 points).

After 3 months, both groups showed a decrease in the index level. The main group had a significantly lower value of the parameter on the WOMAC scale than the comparison group (p <0.05). However, no significant changes in the index were observed after 6 and 12 months, and the values in both study groups were not statistically different.

The present study evaluated the dynamics of the total WOMAC score in patient groups who underwent HA using different approaches. Before surgery, the values in the study groups did not differ (range: 129.7–130.9 points) (Table 5). After 1 month, the value of this parameter in the main group decreased to 92.2±8.3 points, which was significantly lower (p <0.05) than that in the comparison group (115.7±7.8 points).

At 3 and 6 months after surgery, the pain index value continued to decrease in both groups, and the correlations remained consistent. The main group had a statistically significantly lower index value (p <0.05) than the comparison group.

However, after 12 months, the total WOMAC scores for groups 1 and 2 were 73.2±6.9 and 66.8±7.3 points, respectively, and the differences were not statistically significant (p=0.089).

The total Harris Hip Score was slightly higher in the main group than in the comparison group 1 month after HA. However, no significant intergroup differences were observed (Table 6).

Table 3. Dynamics of stiffness assessment according to the WOMAC scale, points (*M±m*)

Study period	Group 1 (comparison group), *n*=78	Group 2 (main group), *n*=85
Before surgery	95,3±8,9	96,1±9,5
After 1 month	83,9±6,5	66,5±7,3*
After 3 months	70,5±7,3	58,8±5,7*
After 6 months	61,4±6,5	54,3±5,9
After 12 months	54,2±5,3	49,2±6,2

Table 4. Dynamics of assessment of functional activity according to the WOMAC scale, points (*M±m*)

Study period	Group 1 (comparison group), *n*=78	Group 2 (main group), *n*=85
Before surgery	7,31±0,87	6,93±1,01
After 1 month	6,68±0,63	5,89±0,74*
After 3 months	6,19±0,79	5,41±0,65*
After 6 months	5,98±0,43	5,63±0,52
After 12 months	5,83±0,64	5,59±0,45

Table 5. Dynamics of the total score on the WOMAC scale, points (*M±m*)

Study period	Group 1 (comparison group), *n*=78	Group 2 (main group), *n*=85
Before surgery	130,9±8,9	129,7±10,3
After 1 month	115,7±7,8	92,2±8,3*
After 3 months	98,7±6,6	81,7±7,5*
After 6 months	85,8±7,3	76,5±6,8*
After 12 months	73,2±6,9	66,8±7,3

Table 6. Evaluation of the total score of the Harris Hip Score scale, points (*M*±*m*)

Study period	Group 1 (comparison group), *n*=78	Group 2 (main group), *n*=85
Before surgery	40,7±3,3	41,3±3,9
After 1 month	72,2±6,7	80,9±7,8*
After 3 months	79,7±7,3	91,8±8,4*
After 6 months	85,3±5,9	93,2±6,5
After 12 months	84,8±3,8	92,8±4,7

Note. * — statistically significant intergroup differences (p <0.05) when compared with the corresponding indicator of group 1 (Mann–Whitney test).

After 1 month, the value of this parameter increased to 80.9±7.8 points in the main group, which was statistically significantly higher (p <0.05) than that in the comparison group (72.2±6.7 points).

After 3 months, the value of this parameter increased in both groups of patients. The total Harris Hip Score in the main group was significantly higher (p <0.05) than that in the comparison group. The values in groups 1 and 2 were 79.7±7.3 and 91.8±8.4 points, respectively.

After 6 and 12 months, the value of this parameter was slightly higher in the main group than in the comparison group, although the differences were not statistically significant (p=0.094).

DISCUSSION

Endoprosthesis is the primary surgical method for treating hip joint pathology [21–23]. Although various approaches to performing HA have been proposed, a consensus on the optimal surgical method regarding effectiveness and safety remains unclear [24, 25].

The study results indicate several advantages of using DDA in HA. The use of DDA in HA is associated with less severe pain, faster recovery of hip joint functionality, and shorter hospital stays compared with the anterolateral approach, which was confirmed by the following statistically significant intergroup differences:

- Lower subjective pain scores on VAS in the DDA group than in the anterolateral approach group
- Lower scores on the pain subscale of the WOMAC questionnaire
- Higher scores on the pain subscale of the Harris Hip Score questionnaire
- Lower scores on the functional activity subscale of the WOMAC questionnaire
- Higher scores on the function subscale of the Harris Hip Score

Considering the less-invasive and traumatic nature of DDA compared with the standard anterolateral approach, it is reasonable to use this approach for all patients indicated for HA, including patients with coxarthrosis and pronounced degenerative changes in the hip joint, persistent joint function impairment, and symptomatic coxarthrosis with any severity of degenerative changes in the absence of conservative therapy efficacy.

The obtained data are consistent with the results reported by other authors. For instance, a meta-analysis of data from seven randomized controlled clinical trials involving 600 patients conducted by Peng et al. [26] compared the use of DDA and PA in primary HA. The study showed that the duration of surgery was on average 13.74 min longer with the use of DDA (95% CI, 6.88–20.61; p <0.0001). No significant differences were found regarding skin incision length, length of hospital stay, blood loss volume, hemotransfusion rate, and complication rate. The patients who underwent HA with DDA had significantly higher early functional outcome scores than those who underwent PA. The use of DDA resulted in better pain scores on the VAS on postoperative days 1 and 2 (p <0.001) and a higher Harris Hip Score at 6 weeks after surgery (p=0.02).

Maldonado et al. [27] have analyzed the results of HA performed between 2008 and 2016. Patients who underwent endoprosthetic replacement using DDA and PA were followed up for 2 years. The study evaluated the Harris Hip Score, Forgotten Joint Score-12 (FJS-12), Veterans RAND 12 Mental (VR-12 Mental), Veterans RAND 12 Physical (VR-12 Physical), and the SF-12 brief quality-of-life questionnaire. The comparison of scores showed that the patients who received DDA had significantly higher scores in VR-12 Mental (p=0.0145), VR-12 Physical (p=0.0236), SF-12 Mental (p=0.0393), and SF-12 Physical (p=0.0391). However, the Harris Hip Score (p=0.0737) and FJS-12 (p=0.2900) were comparable between the groups. Patients who underwent HA using DDA reported a higher quality-of-life than those who underwent surgery using PA.

In an evaluation of the safety of using DDA during HA, Rivera et al. [28] have evaluated the incidence of complications and compared the results with literature data. The retrospective study included patients who underwent HA with DDA and had a follow-up period of at least 1 year. The study was conducted in a large medical center between January 2010 and December 2019. A total of 394 patients underwent HA in 412 hip joints, with a mean follow-up time of 64.8 months (range: 12–120 months). During the follow-up period, revision endoprosthesis was performed in seven cases. Complications observed included cortical perforation, intraoperative fracture of the vertebral and lateral cortical wall, diaphyseal fracture, and late aseptic loosening. Furthermore, the use of DDA was associated with a lower incidence of dislocation. The authors noted that careful patient selection and preoperative planning, a high level of specialist training, and intraoperative visualization can reduce the incidence of complications when performing surgery using this approach.

Taunton et al. [29] have analyzed data from 316 patients who underwent primary unilateral HA. The patients were

randomized into two groups: group 1 underwent DDA intervention and group 2 underwent posterolateral approach (PLA) for HA. When evaluating the intervention, differences in early functional recovery rates were found between performing DDA and using PLA. These differences included the time to discontinuation of walker use (10 and 15 days, p=0.01) and time to discontinuation of all walking aids (17 and 24 days, p=0.04). The only other difference in early functional measures was that 2 weeks after surgery, the mean number of steps per day was 3897 in the DDA group and 2235 in the PLA group (p <0.01).

According to several specialists, HA using minimally invasive DDA can allow femoral elevation without damaging the thigh broad fascia, tensor of the broad fascia, and medial and small gluteal muscles. This is in contrast to the anterolateral and direct lateral approaches. Additionally, DDA enables effective control of limb length restoration while the patient is in the supine position [2, 18, 30–32].

CONCLUSIONS

The study results indicate that using DDA during HA provides the following benefits:

- Good visualization when treating the acetabulum and femur
- No damage to the broad fascia of the thigh and muscle that tenses the broad fascia
- No damage to the greater, medial, and lesser gluteal muscles of the thigh
- Minimization of soft tissue trauma during femoral head removal by traction and dislocation
- Control of limb length recovery, which allows the patient to lie in the supine position
- Convenience of execution for the specialists of the operating team
- Greater ease of X-ray imaging
- Ensuring good stability of the implant while reducing the risk of dislocation
- Reduction in the risk of muscle damage and, consequently, the incidence of postoperative muscle atrophy and dysfunction
- Increased patient mobility during the early postoperative period
- Reduction in the duration of hospitalization and faster rehabilitation of patients after surgery

ДОПОЛНИТЕЛЬНО

Вклад авторов. Все авторы подтверждают соответствие своего авторства международным критериям ICMJE (все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией).

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования и подготовке публикации.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с проведённым исследованием и публикацией настоящей статьи.

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