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The Effect of the Excision of Compressive Osteophytes and Muscle Contractures at Total Hip Arthroplasty Surgery Due to Dysplastic Coxarthrosis on Joint Range of Motion, Clinical Functional Indicators, and Providing Soft Tissue Balance

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Abstract

Introduction. Along with dysplastic coxarthrosis of the hip joint, compression of soft tissues by osteophytes and abductor muscle weakness that is difficult to diagnose clinically and radiologically, muscle-tendon contractures due to surgical operations, bone deformations, length difference in the lower limbs and bone protrusions that hinder joint movement, osteophytes adversely affect the results of surgery. In these cases, great importance is attached to corrective procedures – excision of osteophytes that cause bone compression, restoration of abductor muscle strength, the balance of the joint center and balance of soft tissue in muscle contactures.

Purpose. Study the effect of excision of compressive osteophytes and elimination of muscle contractures during total hip arthroplasty for dysplastic coxarthrosis on range of motion of the joint, clinical functional indicators and providing of soft tissue balance.

Materials and methods. Bone compression during 92 surgeries in the hip joint of 135 patients (125 women) with mean age of 50.9±0.9 at the Arthroplasty and Arthroscopy Department of the Scientific Research Institute of Traumatology and Orthopedics of the Ministry of Health of the Republic of Azerbaijan between 2017–2019 soft tissue balance was ensured by surgical removal of bone compression and the results of these surgeries were studied. The range of motion of the hip joint was evaluated using the Merle d'Aubigne Postel method, clinical complaints were evaluated using the WOMAC osteoarthritis index, and the functional level of the joint was measured using the Harris Hip Scale. In group I (control group, 43 patients) total hip arthroplasty was performed, and in group II (92 patients), tenotomy and excision of osteophytes were also performed to ensure soft tissue balance.

Results. According to the method of Merle d'Aubigne Postel, before surgery, the range of motion of the joint in group I was 10±0.3, and in group II was 9.4±0.2, and after surgery, it was 16.4±0.2 and 16.3±0,2 respectively; The levels of clinical complaints before surgery were 63.1±1.7 in group I, 62.7±1.4 in group II, 6.54±1.2 and 11.1±1.4 after surgery according to WOMAC, respectively. According to the Harris functional scale, before the surgery,

the functional index of the joint in group I was 44.5±2.0, and in group II it was 42.1±1.5. After the surgery, it was 85.3±1.3 and 82.7±1.0, respectively.
Conclusion. Removal of osteophytes, bony protrusions, muscle contractures in the joint and around the joint along with total hip joint replacement surgery due to hip joint disease helps to the reduction or disappearance of patients' clinical complaints in a short period, increase the range of motion and functionality of the joint, medical and social rehabilitation, including the shortening of labor activity periods.
Keywords: dysplastic coxarthrosis, total arthroplasty, soft tissue balance, bone compression, joint range of motion

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Влияние иссечения компрессирующих остеофитов и устранения мышечных контрактур на объем движений сустава, клинико-функциональные показатели и обеспечение баланса мягких тканей при тотальной пластике тазобедренного сустава у пациентов с диспластическим коксартрозом

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Резюме

Введение. Наряду с диспластическим коксартрозом (ДКА) тазобедренного сустава, сдавлением мягких тканей остеофитами и слабостью отводящих мышц, трудно диагностируемой клинически и рентгенологически, нередко наблюдаются мышечно-сухожильные контрактуры вследствие перенесенных хирургических операций, деформации костей, разница в длине нижних конечностей, костные выступы, затрудняющие движение сустава, которые отрицательно влияют на результаты хирургического вмешательства. В этих случаях акцент делается на корригирующие мероприятия – иссечение остеофитов, вызывающих компрессию кости, восстановление силы отводящих мышц, обеспечение баланса суставного центра и мягких тканей.
Цель. Изучение влияния иссечения компрессирующих остеофитов и устранения мышечных контрактур при тотальной пластике тазобедренного сустава по поводу ДКА на объем движений сустава, клинико-функциональные показатели и обеспечение баланса мягких тканей.

Материалы и методы. В отделении артропластики и артроскопии НИИТО Минздрава Азербайджанской Республики в 2017–2019 гг. при тотальной пластике тазобедренного сустава у 135 пациентов (125 женщин) с ДКА в среднем возрасте 50,9±0,9 года в 92 случаях хирургически устранены компрессия кости и мышечные контрактуры, чем обеспечен баланс мягких тканей. Объем движений тазобедренного сустава до и после операции оценивали по методу Merle d´Aubigne Postel, клинические жалобы оценивали по индексу остеоартрита WOMAC, функциональное состояние сустава измеряли по тазобедренной шкале Harris. В I группе (контрольная группа, 43 пациента) выполнена тотальная пластика тазобедренного сустава, во II (92 пациента) – дополнительно тенотомия и иссечение остеофитов для обеспечения баланса мягких тканей.

Результаты. Объем движений в суставе до операции по методике Merle d´Aubigne Postel в I группе составлял 10±0,3, во II – 9,4±0,2, а после операции – 16,4±0,2 и 16,3±0,2 балла соответственно; уровень клинических жалоб до операции составил 63,1±1,7 в I группе, 62,7±1,4 во II группе по WOMAC, 6,54±1,2 и 11,1±1,4 балла после операции соответственно. Функциональный индекс сустава по шкале Harris в I группе составил 44,5±2,0, а во II – 42,1±1,5, после операции – соответственно 85,3±1,3 и 82,7±1,0 балла.

Заключение. Наряду с тотальной пластикой тазобедренного сустава по поводу ДКА, удаление компрессирующих остеофитов, дополнительных костных выступов в суставе и околосуставной зоне и устранение мышечных контрактур приводят к значительному уменьшению или исчезновению клинических жалоб у пациентов в короткие сроки, увеличению объема движений и функциональности сустава, снижению сроков медико-социальной реабилитации и восстановлению трудовой деятельности.

Ключевые слова: диспластический коксартроз, тотальная артропластика, баланс мягких тканей, компрессия костей, объем движений сустава

■ INTRODUCTION

At orthopedic surgery, total hip arthroplasty (THA) is one of the most successful reconstructive surgical operations [1]. So, in the literature about desirable results after this surgery is widely distributed [2, 3]. Adverse clinical outcomes also observed in patients with severe co-morbidities [4], as well as incorrect positioning of the prosthesis, loosening of the implant or wound infection are the main causes of unsuccessful results [5]. On the other hand, in patients with the problem of compression of soft tissues with osteophytes which is difficult to diagnose abductor muscle weakness, muscle-tendon contractures related to surgical operations, bone deformations, length difference in the lower limbs, and bone protrusions and osteophytes that hinder the movement of the joint negatively affect the results of the surgery [6–9]. In these cases, great importance is attached to corrective procedures – excision of osteophytes that cause bone compression, restoration of abductor muscle strength, the balance of the joint center and provision of soft tissue balance in contracture muscles [10, 11].

The ideas of Sir John Charnley, who first proposed and published the term "soft tissue balance", were later adopted by Dorr L.D. was investigated in detail under the term "joint balance" [12]. The increase in the range of motion of the joint and the elimination of compressive factors lead to ensuring stability and increasing the strength of the joint and the limb in general [13]. Therefore, correct restoration of soft tissue balance and removal of osteophytes that interfere with stability and cause compression are key components of surgery. These elements of the surgical operation increase the range of motion of the joint, significantly reduce groin and knee pain, shorten the length difference of the limbs, increase functionality and stability with the increase of offsets.

■ PURPOSE OF THE STUDY

Study of the effect of excision of compressive osteophytes and elimination of muscle contractures during total hip arthroplasty for dysplastic coxarthrosis on range of motion of the joint, clinical functional indicators and providing soft tissue balance**.**

■ MATERIALS AND METHODS

Between 2017–2019, at the Arthroplasty and Arthroscopy Department of the Scientific Research Institute of Traumatology and Orthopedics of the Ministry of Health of the Republic of Azerbaijan 92 surgeries at the hip joints of 135 patients (125 women) with dysplastic coxarthrosis at mean age of 50,9±0,9 were performed at which tissue balance was ensured by removing the compression surgically and the results of the operations were studied. Candidates with articular bone components (osteophytes) were chosen from patients with flexor, adductor, and external rotation contractures before THA surgery, with indications for maintaining balance. Failure to achieve full knee extension at hip joint extension position has been associated with flexor muscles, abduction below 20°, and adduction and flexion below 90–100° with bone compression factor. The patient's gait, the length difference of the lower limbs were studied, and the state of joint muscle contractures was evaluated. For this purpose, the range of motion of the joint was evaluated by the Merle d'Aubigne Postel method, clinical complaints by the WOMAC OAI, and the functional level of the joint by the Harris hip scale [14–16].

The contractured joint capsule and osteophytes were removed by 2 main surgical techniques and soft tissue balance was ensured: in group I (control group, 43 patients), hardened and shortened tendons, especially in the absence of osteophytes, were treated with standard THA, and in group II (92 patients) soft tissue tenotomy and osteophyte excision operations were performed to ensure the balance.

In joints with soft tissue contractures, extra bone(s) formed, low scale indicators of the range of motion of the joint, especially its flexion and abduction movements, were determined before surgery. After the surgery, the differences in the range of motion between the groups disappeared. However, the effect of surgical procedures on the range of motion and functional indicators of the joint in the early period after the surgeries of soft tissue balance, excision of bone components causing compression was not statistically significant. Although extensive bone resection and removal of contractures to ensure balance during surgery resulted in no reduction of clinical complaints in the early period, clinical complaints disappeared statistically significantly during the follow-up examination after 6 months.

Surgical Technique

The length difference of the lower limbs was determined according to clinical standards by measuring the length difference of the kneecaps in the patient lying on the lateral side. According to the surgical protocol, the surgery began with the removal of the joint capsule and the removal of the femoral head from the acetabulum. Opening of the femoral canal and reduction of increased anteversion were achieved after acetabular reaming and placement of the acetabular prosthetic component. After placing the femoral component, the dimensions of the joint head were specified and the tension of the abductor muscles was determined, and the implantation operation was completed by inserting a synthetic joint head of the appropriate size.

In cases where it is impossible to fully open the hip-pelvic joint, tenotomy of m. iliopsoas was performed in the region of the iliopsoas connecting to the lesser trochanter. Subsequently, bony osteophytes around the anterior inferior iliac crest preventing the femur from flexing below 90° were removed. In full extension and external rotation, when the distance between the lesser trochanter and the pelvis is shorter than a finger width, increasing the offset with the femoral head is performed. As a result, in internal rotation, the neck of the femur moves away from the pelvis to the distance of one finger and 90° bending is ensured. At the end of the surgery, Shuck and Dropkick tests were performed to study the soft tissue balance, and the length of the limbs was measured [17].

Clinical Rating Scales

The range of motion of the hip joint was measured by the Merle dAubigne Postel method. In modern orthopedics, the 3-parameter measurement method is widely used for the clinical assessment of joint range of motion for the purpose of determining pain, walking and disability indicators. The highest index of the range of motion of the joint was evaluated with 18 points according to this method.

The Harris Hip Scale was used to compare the function of the joint before and after the THA surgery, and the results of the surgery comparatively [14]. 4 parameters were measured on this scale: pain, function, deformation and range of motion of the joint. In the assessment standard, the highest score (the best possible result) was calculated as 100 points.

The VAS scale was used to assess the localization and intensity (severity) of pain before and after surgery [17]. It is characterized by indicators ranging from 0 to 10 (0 – no pain, 10 – maximum intensity (severe) pain). At the same time, the severity of pain was evaluated in 5 ranges from the absence of pain to the unbearable pain.

The WOMAC OAI was used to assess clinical complaints before and after surgery [3]. It is characterized by indicators ranging from 0 to 100 (0 – no clinical complaints, 100 – extremely severe clinical complaints). For the assessment of clinical complaints, indicators such as pain, joint stiffness and functionality were evaluated.

Statistical Calculations and Analysis

Quantitative data obtained in patients before and after surgery were calculated and analyzed with statistical software (SPSS statistical package version 25.0) and expressed as mean ± standard deviation (SD). The Bonferroni correction test was used for the analysis of these indicators, and the Pearson χ^2 test was used for the analysis of quality indicators. Statistical results were checked by Kruskal – Wallis and Wilcoxon non-parametric tests. A probability level as a statistically reliable indicator was taken as $p<0.05$.

■ RESULTS

Patients were divided into 2 groups in order to study the effect of soft tissue balance and removal of bone compression components on range of motion and clinical-functional indicators of the joint in dysplastic coxarthrosis of the hip joint. At group I, 43 joints in which only THA surgery was performed, at group II, 92 joints in which correction of soft tissues, excition of compresing bony osteophytes were also performed along with THA surgery were studied and clinical results were analyzed.

According to the Merle dAubigne Postel method, the range of motion of the joint in group I before surgery was 10±0.3, and in group II it was 9.4±0.2. After the sugery, this indicator was 16.4±0.2 and 16.3±0.2 points, respectively. Before surgery, the level of clinical complaints according to the WOMAC OAI was set at 63.1±1.7 points in group I and 62.7±1.4 points in group II. After the surgery, this indicator was calculated as 6.54±1.2 and 11.1±1.4 points for the groups, respectively. Before the surgery, the functional index of the joint on the Harris functional scale was calculated as 44.5±2.0 points in group I and 42.1±1.5 points in group II. After the operation, this indicator was 85.3±1.3 and 82.7±1.0 points, respectively (table 1).

The level of clinical complaints in patients of both groups before and after surgery was evaluated according to WOMAC OAI (table 2).

Table 1
Quantitative indicators on functional scales

		Soft tissue balance	
Functional scales and indexes	Number of patients n	Group I	Group II
MD Aubigne pre	Valid n	43	92
	Mean	10.0±0.3	9.4±0.2
MD Aubigne post	Mean	16.7±0.2	16,30.2
WOMAC OAI , pre	Mean	63.1±1.7	62.7±1.6
	Percentile 75	74.0	72.0
WOMAC OAI , post	Mean	6.5±1.2	11.1±1.4
Harris, pre	Mean	44.5±2.0	42.1±1.5
Harris, post	Mean	85.3±1.3	82.7±1.0

Table 2
Level of clinical complaints according to the WOMAC osteoarthritis index

	Balance of the joint	
Clinical complaints and functional indicators	I group	Group II
Before surgery	no difference	no difference
After surgery	down	High
Functionality before operation	high	Down
Functionality after surgery	high	High
Flexion before surgery	high	Down
Flexion after surgery	no difference	no difference
Extension before surgery	high	Down
Extension after surgery	no difference	no difference
Preoperative abduction	high	Down
Postoperative abduction	no difference	no difference

In the early period after surgery, the effect of providing soft tissue balance, excision of bone components causing compression on joint range of motion and functional indicators was not statistically reliable. During this period, clinical complaints were also noticed with great intensity. Clinical complaints decreased significantly only after 6 months and the indicators converged. Joints with soft tissue contractures and extra bony protrusions (osteophytes) had lower joint range of motion, especially joint flexion and abduction, before surgery (table 3).

The relationship between the range of motion which can be achieved by the release of soft tissues during the surgery and the elimination of the factors that cause bone compression,, clinical functional indicators of the joint and sex, age, type of dislocation, the occurrence of pre- and post-operative pain, complications and deformations, gait parameters, complete or partial loss of gait function was studied by the qualitative analysis of the Pearson χ^2 test used to determine its statistical significance by the type of dislocation and preoperative deformations.

Statistically reliable dependence was not found with sex and age indicators, as well as with pain (table 4). Adverse outcomes (complications of fracture type, higher incidence of deformities) were associated with soft tissue contractures, new bone(s) formation, or long-term soft tissue calcification or hardening.

Table 3
Level of clinical complaints according to the WOMAC osteoarthritis index

		Group I	**Group II**
Gender	man	3	7
	woman	40	85
Age group	≤ 60	33	81
	> 60	10	11
Crown Type	type 1	39	10
	type 2	0	62
	type 3	4	20
Complication	no	35	83
	yes	8	9
Harris deformation, pre-op	1 point	4	39
	2 points	4	10
	3 points	29	35
	4 points	6	8
Harris deformation, Post-op	1 point	0	0
	2 points	0	0
	3 points	0	4
	4 points	43	88
Uneven gait, pre-op	no	1	6
	yes	42	86
Uneven gait, post-op	no	38	68
	yes	5	24
Complete gait function loss	no	42	88
	yes	1	4

Table 4
Joint range of motion and clinical functional indicators after surgery

Gender	Chi-square	0.017
	Df	1
	Sig.	0.896 [a]
Age group	Chi-square	2,848
	Df	1
	Sig.	0.091
Crowe Type	Chi-square	82,976
	Df	2
	Sig.	0.000 [*]
The occurrence of complications	Chi-square	2,072
	Df	1
	Sig.	0.150
Pain before surgery	Chi-square	1,473
	Df	2
	Sig.	0.479 [a]
Post-operative pain	Chi-square	0.474
	Df	2
	Sig.	0.789 [a.c]
Deformation before surgery	Chi-square	16,266
	Df	3
	Sig.	0.001 [a,*]
Postoperative deformation	Chi-square	1,927
	Df	1
	Sig.	0.165 [a]
Gait parameters	Chi-square	1,050
	Df	1
	Sig.	0.306 [a]
Gait parameters	Chi-square	3,632
	Df	1
	Sig.	0.057
Loss of gait function	Chi-square	0.336
	Df	1
	Sig.	0.562[a]
* The Chi-square statistic is significant at the 0.05 level		

Statistical analysis between groups with Kruskal – Wallis non-parametric test confirmed the statistical reliability of the indicators of the type of dislocation, the location of the acetabulum and the formation of deformations. Also, the results of flextion, extension and abduction movements due to muscle contractures were also statictically significant (table 5).

The results of the Wilcoxon test: in both groups, after surgery, the range of motion of the joint increased, pain in and around the joint area, and other clinical complaints decreased, the functionality of the joint and the surrounding area increased, flextion, internal rotation, external rotation, adduction, abduction and gait parameters improved ($p<0.05$) (table 6).

Table 5
Joint range of motion and clinical functional indicators after surgery

		n	Mean Rank
	Unprovided	43	61,62
	Provided	92	70.98
	Total	135	
Test Statistics [a,b]			
	Kruskal – Wallis H	df	Asymp. Sig.
Age	6,768	1	0.009
Type of dislocation	55,568	1	0,000
Acetabular deformation	8,754	1	0.003
Joint range of motion after surgery	4,284	1	0.038
Deformation before surgery	13,933	1	0,000
Flextion before surgery	6,710	1	0.010
Extension before surgery	6,516	1	0.011
Abduction before surgery	4,824	1	0.028
a. Kruskal Wallis Test			
b. Grouping Variable: Balance			

Table 6
Joint range of motion and clinical functional indicators after surgery (Wilcoxon test results)

Test Statistics a,b		
	Z	Asymp. Sig. (2-tailed)
MD Aubigne post – MD Aubigne	–8,361 [c]	0,000
Post-op Pain – Pre-op Pain	–7,639 [d]	0,000
Post-op VAS – Pre-op VAS	–8,512 [d]	0,000
Post-op WOMAC – Pre-op	–8,330 [d]	0,000
Post-op Harris – Pre-op Harris	–8,329 [c]	0,000
Post-op Harris pain – Pre-op Harris pain	–8,271 [c]	0,000
Post-op Harris Functionality – Pre-op Harris Functionality	–8,332 [c]	0,000
Post-op Harris deformation – Pre-op Harris deformation	–8,080 [c]	0,000
Post-op volume – pre-op volume	–8,335 [c]	0,000
Post-op flextion – pre-op flextion	–8,300 [c]	0,000
Post-op extension – pre-op extension	–4,264 [c]	0,000
Post-op internal rotation – pre-op internal rotation	–6,970 [c]	0,000
Post-op external rotation – post-op internal rotation	–7,500 [c]	0,000
Post-op abduction – pre-op abduction	–4,589 [c]	0,000
Post-op adduction – pre-op adduction	–6,880 [c]	0,000
Post-op length difference – pre-op length difference	–6,668 [d]	0,000
Post-op uneven gait – pre-op uneven gait	–7,410 [d]	0,000
a. Balance = provided		
b. Wilcoxon Signed Ranks Test		
c. Based on negative ranks		
d. Based on positive ranks		

DISCUSSION

Providing soft tissue balance by the removal of soft tissue contractures during total arthroplasty surgery for dysplastic coxarthrosis, the removal of osteophytes, bony protrusions, and rough scar tissue around the joint, which are obstacles to flextion, abduction, adduction, internal and external rotation movements its removal led to an increase in its functionality, a reduction (disappearance) of pain and other clinical complaints (gait disorders, uneven gait, limb length difference, deformities, etc.). Other authors have also shown in their research that the range of motion of the hip joint, especially in flexion and abduction movements, is low before surgery in joints with soft tissue contractures, additional bone(s), bone protrusions [18, 19]. After the surgery, the disappearance of the difference between groups for most indicators coincides with the latest literature data [20, 21]. Unfavorable results are associated with the severity of the pathology, long-term unjustified conservative treatment, including physical methods, and late referral of patients to specialized centers, as well as long-term bed rest due to severe pathologies, insufficient and low-quality care.

CONCLUSION

This study evaluates the performance of additional surgical procedures during TAP surgery to ensure soft tissue balance, increase range of motion and clinical functionality of the joint in patients with hip disease with osteophytes, extra bony protrusions, muscle contractures (calcification, stiffness, scarring) in and near the joint. highlights the necessity. As a result, patients' clinical complaints decrease or disappear in a short period of time, the range of motion and functionality of the hip joint increases, and the periods of medical-social rehabilitation and labor recovery are shortened.

Restrictions of the Study

The main limitations of the study we present are that it is a single-center prospective study. Secondly, the number of patients in the control group was less than 2 times that of the main group. Thirdly, the absolute composition of patients in both groups was different due to co-morbidities. This does not exclude distortions in the final results.

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