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ASSESSMENT OF THE MODIFIED SOFT TISSUE RELEASE METHOD IN TOTAL HIP JOINT ARTHROPLASTY ON THE BASIS OF DYSPLASTIC OSTEOARTHROSIS OF HIP JOINT THAT DEVELOPED DUE TO ITS CONGENIAL DISLOCATION (CROWE TYPE III AND IV).

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Abstract

Objective: *We have developed the original methodology of endoprosthesis, which can be used in dysplastic osteoarthrosis of Crowe types III and IV. The purpose of our research was to make a comparative analysis of results after arthroplasty between the traditional method and the method we have worked out for Crowe IV type dysplastic osteoarthrosis.*

Material and methods: *We have studied the consequences of arthroplastic interventions among 106 patients, aged 18-85, with Crowe types III and IV of dysplastic osteoarthrosis.*

Harris scale was used for the final assessment.

While planning the surgical procedure we use radiography and if necessary we apply Computed Tomography with 3D reconstruction to the hip joint.

Statistical analysis: *Reliability of true dissimilarities between the results is established by the criteria of Pearson c^2. The material was processed with statistical program package SPSS 22.*

Results: Both groups are identical before the surgical intervention $p>0.05$.

According to the Harris scale, the indicators of patients' conditions before the arthroplasty are rather similar. However, after the surgery, the overall assessment of functional indicators increases from 39.5+18.95. to 92.6+ 8.04 in case of modified release and from 41.03+15.5 to 83.7+ 12.1 in case of traditional method respectively($p<0.05$).

Conclusion: *Modified flesh release method of arthroplasty, in comparison with traditional one, improves the functional results of dysplastic osteoarthrosis developed on the basis of congenital dislocation of thigh joint, and is recommended to be applied in cases of high-grade dysplasia (Crowe type III and IV).*

Keywords: *total hip arthroplasty, surgery technique, developmental dysplasia, Crowe type III and IV*

Introduction

Arthroplasty of the hip joint is one of the mostly spread surgical procedures in the world [*López-López JA et al., 2017*], but nowadays, total arthroplasty in dysplastic osteoarthrosis is still considered to be a great challenge. Dysplastic osteoarthrosis is a degenerative-dystrophic disease that is developed during congenital dysplasia of the hip since the delineation of areas causes arthritis at the young age [*Kumar EM, Kumar GY et al., 2018*]. Anatomy of dysplastic hip is usually significantly altered. Acetabulum and femur are underdeveloped and femur is often displaced. Hip biomechanics is altered and there is no ideal stimulation for the development of proper acetabulum and proper femoral head. Different morphological alterations are seen not only on femur and acetabulum but also on pelvis. The deformity of the acetabulum and the femur in developmental dysplasia of the hip is complex and may include malformation in all three planes [*Hartofilakidis G, Yiannakopoulos C et al.,2008]*. Typical dysplastic joints are characterized by improper location of femur socket and

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the neck of femur, in the result of which most patients suffer from pain in the joint and malfunction of the hip and the acetabulum [*Kılıçarslan K et al., 2011; Greber EM et al.,2017*].

In case of I and II type dysplasia the results of total arthroplasty are positive and verge towards the results achieved during the medical intervention in case of osteoarthrosis without dysplasia. While speaking about severe cases of dysplasia, the unfavorable outcomes occur rather frequently [*Boyle MJ et al., 2012, Yang, S., Cui, Q. 2012, Mu W, Yang D, MJ et al.,2016*]. Arthroplasty among such patients turns to be technically complicated due to incorrect development of femur sockets and bone of femur, as well as incompliance to the length of legs [*Yalcin N et al., 2010; Bicanic G et al.,2014*].

The major technical problem in patients with a low dislocation, is reconstruction of the natural acetabulum. In those with a high dislocation, the challenge is to place the acetabular component inside the reconstructed true acetabulum and to use an appropriate femoral implant in the hypoplastic narrow femoral diaphysis [*Hartofilakidis G, Karachalios T. 2004*]. When surgeons perform total hip arthroplasty for hips with a high dislocation related to developmental dysplasia of the hip, obtaining long-term stable implant fixation and optimizing patient function is challenging. [*Krych AJ et al.,2009*].

Soft tissue considerations in patients with congenital developmental dysplasia of the hip are also important. Patients with severe developmental dysplasia, often have inefficient abductor musculature leading to limp or frank trendelenburg gait. Musculature around the hip including the adductors, hip flexors, and hip extensors are shortened due to chronic dislocation [*Lai KA, et al.2005; Yang, S., Cui, Q. 2012*].

Expansion of the motion in the joint as well as recovery of the normal biomechanics of the joint is counted to be the most problematic issues nowadays. To perform total hip arthroplasty (THA) in adult patients with high hip dislocation, various surgical techniques have been described in the literature, such as: the arthroplasty in combination with a subtrochanteric shortening osteotomy and with placement of the acetabular component at the level of the anatomic hip center [*Krych AJ et al.,201; Ollivier M et al.,2016*]. Shortening of the femur is of importance for minimizing risk of damaging neurovascular structures due to excessive limb lengthening. Furthermore, reduction of the femoral head into the true acetabulum, remains challenging without shortening of the femur [*Neumann D et al.,2012*]. However, these procedures generally lead to a significant leg-length discrepancy as well as muscle weakness [*Zhao X, Zhu ZA et al., 2011*] Lai K and co-authores applied the release method following iliofemoral monotube soft tissue distraction [*Lai KA et al.,2005; Holinka J et al.,2011,*].

Although there are several methods to solve this problem, this issue still remains unsolved. We have developed the original methodology of endoprosthesis, which can be used in case of dysplastic osteoarthrosis of Crowe type III and IV [*Kapanadze G et al.,2011*].

The purpose of our research is to make a comparative analysis of results after arthroplasty between the traditional method and the method we have developed in case of Crowe IV type dysplastic osteoarthrosis.

Material and methods

We have studied the consequences of arthroplastic interventions among 106 patients, aged 18-85, who had Crowe type III and IVs of dysplastic osteoarthrosis [*Crowe JF et al.,1979*]. They underwent arthroplastic surgery via our developed method in Z. Tskhakaia West Georgia Interventional Medicine Center, as well as Al. Aladashvili Clinic, Saint Ioane Motskale Private Clinic and Batumi Maritime Hospital. Among the patients there were 83women and 23 men. As a control group we used 95 patients treated by traditional method.

Including criteria: III-IV type of osteoarthrosis (Crowe).

Exclusion criteria: Rheumatoid arthritis and other severe systemic diseases.

We studied the functional condition of the pelvic hip enclosing: pain, ability of motion, self-ser-

vice and joint flexibility. Harris scale was used for the final assessment.

While planning the surgical procedure we use radiography and in case of necessity we apply to thigh joint CT with 3D reconstruction.

Surgery Technique: All surgical procedures were carried out by the senior author. Arthroplasty is executed via front-side approach, according to Bauer. We applied both cemented and cementless bipolar hip prosthesis as well as (Müller and Bush Schneider) socket reconstruction shells. Following the resection of the cup of thigh and after processing of femur socket, we implemented excision of osteophytes and front capsulectomy.

During the operation, we executed the exfoliation of m.ileopsoas and rotators (m.piriformis, m. gemelus superios, m.obturatos inferior, m. Gemelus inferior, m.quadriceps). From the place of attachment to the bone, the muscular masses are exfoliated together with periosteum, the level of exfoliation depends on the width of the desired ambulation. Periosteum is exfoliated from the total surface of the minor trochanter and is fixed to the upper third of the medial surface of thigh. It represents a common clasp for all muscles attached to the minor trochanter and ensures the development of the desired compression.

Fixation of socket component is made into the genuine socket that allows the full recovery of biomechanics. In case of necessity, reconstruction of socket is made by the autologous bone extracted from the top of the thigh. Correction of the artificial socket is done in compliance with the anatomic area.

Statistical analysis Reliability of true dissimilarities between the results is established by the criteria of Pearson c^2. The material was processed with statistical program package SPSS 22.

RESULTS

We examined dissimilarities between the functional indicators of the joint in the testing and investigative groups during pre and post treatment periods (Table 1).

Both groups are identical before the surgical intervention $p>0.05$. After arthroplasty, reduction of pain has been spotted in both groups. Number of patients with no sign of pain, is insignificantly higher in modified release group.

Limping is significantly lower in modified release group, whereas symptoms of moderate and severe limp are significantly higher in the control group.

The number of patients who walk without stick is truly higher in the modified release group, while the number of those patients who need stick support all the time and for long distances is higher in testing group. Walking distance components are also high in the modified release group. There were no true dissimilarities between the groups in terms of patients' ability to put on socks. The number of patients unable to sit is significantly higher in the traditional treatment group. The ability to climb the stairs normally and to use transportation is significantly larger patient in the modified release group.

The special advantage of our method is the increase of motion capacity among the patients in comparison with the results of traditional arthroplasty. After arthroplasty the flexion 0-45° is truly higher in testing group and 110-140° in modified release group. There is no limitation of abduction up to 0-15° in the release group. Abduction 15-20° is truly higher in testing group while the abduction indicator is 20-60° in the modified release group. On top of that, indicators of adduction and rotation are truly improved in new method group. The diagram N1 shows the functional results according to the Harris scale. As shown in the diagram, after modified release operation, the functional indicators of thigh joint are significantly improved according to all parameters compared with that of traditional treatment. According to the Harris scale, the indicators of patients' conditions before the arthroplasty are rather similar. However, after the surgery, the overall assessment of functional indicators increases from 39.5+18.95. to 92.6+ 8.04 in case of modified release and from 41.03+15.5 to 83.7+ 12.1 in case of traditional method respectively($p<0.05$).

Table 1

Functional indicators of the joint in the testing and control groups during pre and post treatment periods, according to Harris hip score.

		Preoperative					Postoperative				
		Modified release group, n=106		Control group, n=95		p	Modified release group, n=106		Control group, n=95		P
		abs	%	abs	%		abs	%	abs	%	
Pain	None, or ignores it	0	0.00	0	0.00	-	90	84.91	81	85.26	0.9203
	Slight	11	10.38	15	15.79	0.2542	15	14.15	9	9.47	0.3078
	Mild	28	26.42	33	34.74	0.2003	1	0.94	2	2.11	0.4976
	Moderate	37	34.91	27	28.42	0.3247	0	0.00	3	3.16	0.0652
	Marked, serious limitations	21	19.81	16	16.84	0.5902	0	0.00	0	0.00	-
	Totally disabled	9	8.49	4	4.21	0.2176	0	0.00	0	0.00	-
Limp	None	0	0.00	0	0.00	-	57	53.77	15	15.79	<0.0001
	Slight	3	2.83	5	5.26	0.3771	44	41.51	45	47.37	0.4028
	Moderate	16	15.09	22	23.16	0.1454	4	3.77	27	28.42	<0.0001
	Severe	78	73.58	64	67.37	0.3349	1	0.94	8	8.42	0.0105
	Unable to walk	9	8.49	4	4.21	0.2176	0	0.00	0	0.00	-
Support	Without Cane	1	0.94	5	5.26	0.0723	97	91.51	46	48.42	<0.0001
	With stick on long distance	3	2.83	7	7.37	0.1398	8	7.55	34	35.79	<0.0001
	One crutch	34	32.08	30	31.58	0.9203	1	0.94	14	14.74	13.80
	Cane/Walking stick most of the time	24	22.64	19	20.00	0.6468	0	0.00	1	1.05	1.12
	Two Canes/Walking sticks	35	33.02	30	31.58	0.8231	0	0.00	0	0.00	-
	Two crutches or Wheelchair	9	8.49	4	4.21	0.2176	0	0.00	0	0.00	-
Distance walked	Unlimited	0	0.00	0	0.00	-	36	33.96	2	2.11	<0.0001
	Six blocks (30 minutes)	12	11.32	17	17.89	1.75	69	65.09	91	95.79	<0.0001
	Two or three blocks (10- 15 minutes)	60	56.60	42	44.21	0.1859	1	0.94	2	2.11	0.4976
	Indoors only	25	23.58	32	33.68	0.1124	0	0.00	0	0.00	-
	Bed and chair	9	8.49	4	4.21	0.2176	0	0.00	0	0.00	-
Ability to put on socks and shoose	Easily	4	3.77	9	9.47	0.101	70	66.04	52	54.74	0.1016
	With difficulties	48	45.28	45	47.37	0.7642	45	42.45	38	40.00	0.729
	Unable	54	50.94	51	53.68	0.6985	1	0.94	5	5.26	0.0723
Sitting ability	Any type of chair for 1h	14	13.21	17	17.89	0.3594	88	83.02	66	69.47	0.0235
	High chair for 0,5 h	59	55.66	44	46.32	0.1859	17	16.04	16	16.84	0.8875
	Unable to do for 0,5 h	33	31.13	34	35.79	0.4839	1	0.94	10	10.53	0.0029

TABLE 1 (Contunied)

		Preoperative					Postoperative				
		Modified release group, n=106		Control group, n=95		p	Modified release group, n=106		Control group, n=95		p
		abs	%	abs	%		abs	%	abs	%	
Stairs	Normally	0	0.00	0	0.00	-	90	84.91	65	68.42	0.0055
	Normally with banister	21	19.81	17	17.89	0.729	10	9.43	19	20.00	0.0333
	Any method	61	57.55	55	57.89	1	5	4.72	8	8.42	0.2857
	Not able	24	22.64	23	24.21	0.7913	1	0.94	3	3.16	0.2617
Enter, public transport (bus)	Able to use transportation	19	17.92	14	14.74	0.543	101	95.28	85	89.47	0.1175
	Unable to use public transportation	87	82.08	81	85.26	0.543	5	4.72	11	11.58	0.0727
Deformity	Deformity	77	72.64	71	74.74	0.7401	15	14.15	33	34.74	0.0006
	Absence of Deformity	29	27.36	24	25.26	0.7401	91	85.85	62	65.26	0.0006
Flexion	$0\text{-}45^0$	80	75.47	61	64.21	0.0817	1	0.94	10	10.53	0.0029
	$45\text{-}90^0$	24	22.64	29	30.53	0.2059	15	14.15	19	20.00	0.2694
	$90\text{-}110^0$	2	1.89	5	5.26	0.6629	71	66.98	58	61.05	0.3802
	$110\text{-}140^0$	0	0.00	0	0.00	-	19	17.92	8	8.42	0.0486
Abduction	$0\text{-}15^0$	72	67.92	61	64.21	0.5777	0	0.00	4	4.21	0.0329
	$15\text{-}30^0$	24	22.64	33	34.74	0.0574	3	2.83	18	18.95	0.0002
	$0\text{-}60^0$	1	0.94	1	1.05	0.9203	103	97.17	73	76.84	<0.0001
Adduction	$0\text{-}15^0$	80	75.47	78	82.11	0.2524	3	2.83	25	27.37	<0.0001
	$15\text{-}60^0$	26	24.53	17	17.89	0.2524	103	97.17	70	72.63	<0.0001
External rotation in extension to	$0\text{-}30^0$	90	84.91	79	83.16	0.7401	2	1.89	31	32.63	<0.0001
	$30\text{-}60^0$	16	15.09	16	16.84	0.7401	104	98.11	64	67.37	<0.0001

Clinical case

Patient T.T, femail, 57 years old, presented to the clinic with the diagnosis of IV grade osteoarthrosis of the right thigh joint (Fig. 1). Complaints: Permanent pain, limitation in motion, takes non-steroidal sedatives. Flexion 25^0, abduction - 10^0, and adduction 15^0, leg is shortened up to 9 *cm*. The movement of toes and sensitivity was not afflicted. X-ray revealed dysplastic femur socket, Shenton line was impaired.

Total cementless arthroplasty with flesh modified release method was carried out with autologous bone engrafting (Fig. 2) (manufacturer of prosthesis "Serf", socket 55, liner 55, leg 2, head S).

Outcomes: Post-operational rehabilitation was successful. The patient does not complain of pain or lameness; movement in joint is fully restored, the patient can move without any means of support, Harris score is 96.

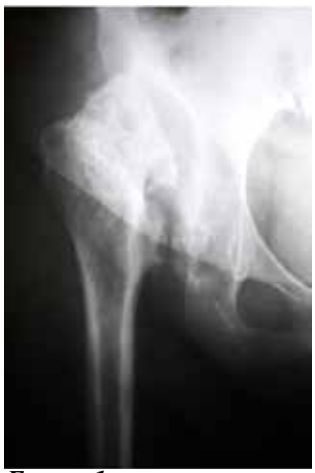

FIGURE 1.

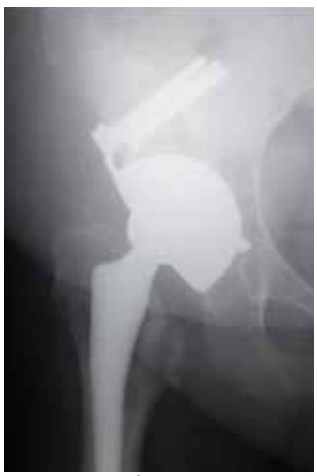

FIGURE 2.

Discussion

During the osteoarthrosis that developed on the basis of dysplasia, the following indicators have been spotted: increase of neck-diaphysic angle, decrease of Wiberg angle, deterioration of vertical compliance angle, as well as incompliance of femur socket and thigh head centers. Mentioned changes cause dysfunction of the joint biomechanics. Instability causes the allocation of the load from upper side to upper-outer part, whereas the excessive antitorsya endures the excessive pressure on front cover of femur socket. As a result, the joint rotation center is changed. Greater is the subdislocation quality, the more neck antitorsya is expressed, followed by the deterioration of the head size and shape. The x-ray indicator changes, related to femur socket, proximal part of thigh bone and compliance of socket and head, are inter-related during dysplastic coxarthrosis [*Nozadze T., Katsitadze T.2010*]. In such cases, changes in bone and flesh structures take place leading to the complication of arthroplasty. From the perspectives of biomechanics, allocation of acetabular component in genuine socket impacts the improvement of functional results as well as prosthesis lifespan. However, for the stability of acetabular component, high transplantation, medialization or centering with higher coxa can be used. Inserting thigh component can be implemented with and without osteotomy [*Tözün IR et al.,2007*]. The methodology developed by us envisaged such correction of muscular-tendon apparatus that ensure the development of desired muscular contraction, expansion of the motioning volume and allocation of acetabular component in the genuine socket in post-surgical period.

Conclusion

Modified flesh release method of arthroplasty, in comparison with traditional one, improves the functional results of dysplastic osteoarthrosis developed on the basis of congenital dislocation of thigh joint, and is recommended to be applied in cases of high-grade dysplasia (Crowe III - IV).

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