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A case report

Total hip arthroplasty with subtrochanteric shortening osteotomy using derotational plate: A clinical case

Durdana Oktyabrova [1], Kairat Ashimov [2], Berk Guclu [3], Mukhtar Abilmazhinov [4], Bekzhan Suleimenov [5], Timur Baidalin [6], Askarjan Beknazarov [7], Erdaulet Agabekov [8]

[1] *Orthopedic traumatologist, National Scientific Center of Traumatology and Orthopedics named after academician Batpenova N.D., Astana, Kazakhstan. E-mail: oktyabrovadana@gmail.com*

[2] *Head of Department of Orthopedics No. 3, National Scientific Center of Traumatology and Orthopedics named after academician Batpenova N.D., Astana, Kazakhstan. E-mail: kairat_ashimov@mail.ru*

[3] *Head of the Department of Traumatology and Orthopedics, Ufuk University, Ankara, Turkey. E-mail: gucluberk@yahoo.com*

[4] *Head of the Department of Traumatology and Orthopedics, Astana Medical University, Astana, Kazakhstan. E-mail: salta_sso@mail.ru*

[5] *Orthopedic traumatologist, National Scientific Center of Traumatology and Orthopedics named after Academician Batpenov N.D., Astana, Kazakhstan. E-mail: bekjan-suleimen@mail.ru*

[6] *Head of the Department orthopedics No7, National scientific center of traumatology and orthopedics named after academition Batpenov N.D., Astana, Kazakhstan. E-mail: t.baidalin@gmail.com*

[7] *Orthopedic traumatologist, National Scientific Center of Traumatology and Orthopedics named after Academician Batpenov N.D., Astana, Kazakhstan. E-mail: dr.askar1990@gmail.com*

[8] *Orthopedic traumatologist, National Scientific Center of Traumatology and Orthopedics named after academician Batpenova N.D., Astana, Kazakhstan. E-mail: yerdaulet.21@mail.ru*

Abstract

Dysplasia of the hip joint (DDH) is a severe pathology of the musculoskeletal system which, if not diagnosed and treated in time, leads to impaired function of the hip joint. This leads to osteoarthritis, which requires surgical intervention.

This case report describes a case where a cementless total hip arthroplasty (THA) of the left hip joint with a 6.5 cm transverse subtrochanteric shortening osteotomy (SSO) was performed.

A special feature was the use of a newly developed plate that provides rotational and axial stability at the osteotomy site. With further observation and management of the patient. It is worth noting that this study and follow-up of the patient is ongoing.

Keywords: developmental dysplasia of the hip (DDH), arthroplasty, subtrochonteric osteotomy.

Corresponding author: Durdana Oktyabrova, PhD student at the Astana Medical University, traumatologist-orthopedist, National scientific center of traumatology and orthopedics named after academician N.D. Batpenov, Astana, Kazakhstan.
Postal code: Z10K8Y7
Address: Kazakhstan, Astana, Beibitshilik str, 49A
Phone: +7 747 989 4746
E-mail: oktyabrovadana@gmail.com

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Introduction

Developmental dysplasia of the hip (DDH) has long been considered one of the complex types of musculoskeletal deformities. Despite the extensive history of this condition and the efforts of many specialists in the field, little is still known about the exact cause of DDH [1].

This condition involves the affection of various structures such as the femur, acetabulum, muscles, tendons, and neurovascular bundle [2-4]. As a result, the biomechanics of the hip joint are altered, leading subsequently to secondary osteoarthritis, known as dysplastic coxarthrosis (DC).

The main treatment method for DC is considered to be total hip arthroplasty (THA). In most cases of Crowe IV type dysplasia, due to anatomopathological changes, THA is used in combination with a subtrochanteric shortening osteotomy (SSO) [5, 6]. This surgical procedure aims to alter the length of the femur and the diameter of the medullary canal, creating more favorable conditions for the implantation of an artificial joint and avoiding sciatic nerve neuropathy [7-9]. To achieve union at the osteotomy site, many authors in the literature describe the use of various fixation methods. The choice of specific methods is determined by individual patient characteristics and the nature of bone tissue deficit. Although endoprosthetic replacement with SSO yields certain outcomes, this approach has several drawbacks. Due to the complexity of the treatment technique, these patients also face increased risk of postoperative complications. Overall, this surgery is quite complex but necessary for restoring hip joint function and improving the patient's quality of life.

In this report, we describe a clinical case of a patient with left-sided Crowe type IV DDH, who underwent surgery using a domestically produced plate.

Case Presentation

A 35-year-old female patient has been hospitalized in the endoprosthetics department at the National Scientific Center for Traumatology and Orthopedics named after Academician N.D. Batpenov. She complains of pain, limited movement, and impaired function in the left hip joint, as well as a limp. Since birth, she has been observed by an orthopedist with a diagnosis of "congenital dislocation of the left hip," and there is no history of any surgical treatment.

During the physical examination, it was noted that the patient moves without additional support aids, limping on the left lower limb. Visually, muscle hypotrophy of the left thigh and buttock, and lumbar hyperlordosis (Figure 1). Movements in the left hip joint are limited and painful: flexion-extension 100º-0-15, abduction-adduction 20º-0-15º, external-internal rotation 10º-0-3º. The following questionnaires were used for clinical preoperative and subsequent postoperative assessment: Harris Hip Score (HHS), Oxford Hip Score (OHS), and Visual Analog Scale (VAS).

a *b* *c*

Figure 1 - Preoperative patient's appearance: (a) front, (b) right side, (c) back

At the preoperative stage, radiography in the direct projection and computed tomography (CT) were performed, revealing left-sided dysplastic coxarthrosis type IV according to Crowe, and neoarthrosis at the level of the iliac wing (Figure 2). In addition to the aforementioned instrumental examination methods, teleroentgenography was done to determine the length of the shortening osteotomy (Figure 3).

a *b* *c*

Figure 2 - Preoperative X-ray and CT of the hip joint: (a) X-ray in direct projection; (b) CT in direct projection; (c) CT in posterior projection

In laboratory tests, all indicators were within normal limits.

Based on the aforementioned data, the diagnosis is as follows: Crowe type IV dysplasia of the left hip joint, neoarthrosis at the level of the iliac wing, mixed contracture of the left hip joint.

After a thorough analysis of her condition and discussion of all possible treatment options, the patient

was offered surgical intervention in the form of total hip arthroplasty of the left hip joint. However, in this case, the surgical intervention was not limited to a simple joint replacement. To achieve the best result and improve the patient's functional capabilities, a SSO was chosen.

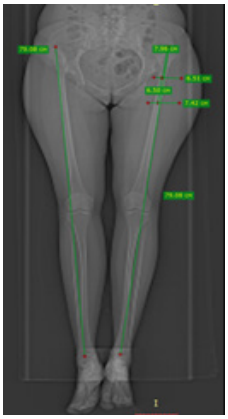

Figure 3 - Teleroentgenography of the lower extremities

The operation was performed with the patient lying on her right side under intubation anesthesia with perineal fixation. A layered incision was made along the Harding approach on the lateral surface up to 16 cm to expose the hip joint. The trochanteric region was exposed, and the capsule of the joint was partially excised from the anterior surface. After opening the area of the neoarthrosis, the femoral head was resected. To facilitate locating the true acetabulum, a transverse osteotomy of the subtrochanteric region was performed. The hypertrophied capsule was excised, and the true position of the acetabulum was identified. The acetabulum was reamed with spherical reamers to size 44, and a press-fit acetabular component size 44 was installed. The acetabular component was submerged 95%, secured with two screws, and a polyethylene liner was placed. Subsequently, the femoral canal was rasped up to size 6. A trial reduction of the proximal fragment with the head and overlapping of the distal fragment of the femur was performed. The difference was marked with an electrocautery device as a mark on the femur. Intraoperatively, the femur was initially resected to 5 cm. Given the pronounced retraction, an additional resection of up to 1.5 cm was performed. The resulting femoral fragments were connected with the prosthesis stem. Due to the presence of rotational and axial mobility, the osteotomy zone was fixed with our developed domestic derotational plate (№ KZ8955 29.03.2024) with locking screws. After confirming the stability of the construct, the prosthesis head size S (28) was placed on the femoral component, and the head was reduced into the acetabular component by extending, pulling along the axis, and internally rotating the leg (Figure 4). After reduction, the range of motion and joint stability were checked, and no spontaneous dislocation occurred at maximum range of motion. The wound was sutured in layers with a paraosseous silicone drain left in place. Blood loss was 500 ml, and the operation time was 140 minutes.

a *b* *c*

Figure 4 - Intraoperative images: (a) Measurement of the osteotomy length; (b) Implantation of the femoral component of the endoprosthesis; (c) Fixation of the osteotomy zone with a derotational plate

Upon completion of the surgery, to make sure that the components were correctly positioned, the hip joints were radiographed in direct projection, and there was no evidence of incorrect positioning. (Figure 5).

Figure 5 - Postoperative X-ray of the hip joint in direct projection: after 1 week

In the early postoperative period, the patient complained of severe localized pain, which was managed with an opioid analgesic administered once. No vascular or neurological disturbances were observed in the peripheral lower limbs.

From the first day after the surgery, the patient began the first stage of rehabilitation activities. On the second day, the patient was mobilized, walking with crutches without

bearing weight on the operated limb. Subsequently, after the surgical wound had healed, the patient was discharged on the 10th day for outpatient treatment with an improvement in overall condition.

Three months after the surgery, the patient began the second stage of rehabilitation treatment, which included active mechanotherapy, amplipulse therapy, transcutaneous electrical nerve stimulation, galvanization, lower limb massage, and kinesiotherapy. Over time, significant progress was noted in the recovery of hip joint function. The patient moves independently with the help of a cane, limping on the left lower limb but with full support on it. The gait pattern is smoother, indicating noticeable improvements in coordination and balance. Importantly, there is a positive trend in muscle development, with an increase in muscle mass. Additionally, the range of motion in the left hip joint shows progress

In the preoperative period, the scores VAS 7, HHS 75 and OHS 37. In the early postoperative period, before discharge, the patient's questionnaire was repeated and the VAS score changed slightly to 4, but the HHS score was 55 and OHS score was 30, showing some deterioration due to right hip problems. After rehabilitation treatment after 3 months, the questionnaire results improved, the patient was completely free from pain as the VAS score was rated 0. The results of separate questionnaire HHS 70 and OHS 33 (Table 1.).

Table 1 - Clinical Outcomes

Questionnaires	Before the operation	After surgery, before leaving the hospital	After 3 month
VAS	5	0	0
HHS	75	55	70
OHS	37	30	33

In laboratory analyses, there are no signs of inflammation. On the X-ray taken 3 months after the surgery, there are no signs of instability, there is a tendency to fusion of the osteotomy zone, and after 6 months, bone callus formation with complete fusion is noted (Figure 6).

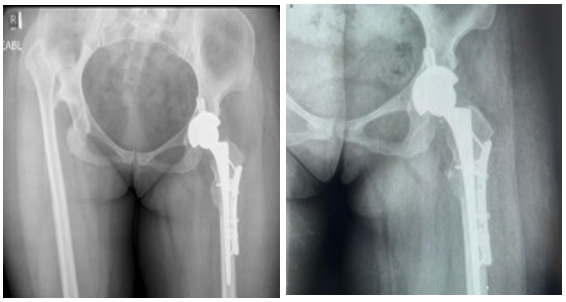

Figure 6 - Postoperative X-ray of the hip joint in direct projection: (a) after 3, (b) after 6 months

Table 1 presents data on the MRC Scale, comparing results before and after rehabilitation measures, indicating positive dynamics of the treatment administered (Table 2).

Table 2 - MRC- Scale

Title	Before rehabilitation treatment	After rehabilitation treatment	Effectiveness Result
Adapted Karnofsky Performance Scale	60	70	10
Goniometry	Fl (80)-0-Ex (10). add(25)-0-abd(25). Rt ex(15)-0-Rt in(15)	Fl (85)-0-Ex (15). add(25)-0-abd(25). Rt ex(15)-0-Rt in(15)	Flexion 5 Extension +5
MRS scale quadriceps muscle	3	4	1
ICF b280. Pain	2	1	1
ICF d230. Daily activity	3	2	1
ICF b730. Muscle strength	3	2	1
ICF b710. Joint mobility	3	2	1
ICF s75001. Structure of the lower limb of the hip joint	2	1	1
ICF d450 Walking	3	2	1
ICF b5105 Swallowing	0	0	0
ICF b810 Skin protective functions	0	0	0
ICF d510 Washing	0	0	0
ICF d530 Physiological functions	0	0	0
ICF d465 Movement with technical devices	2	1	1
ICF b410 Heart function	0	0	0
ICF b110 Consciousness function	0	0	0
ICF d440 Precision hand movements	0	0	0
ICF d445 Hand and arm use	0	0	0 Effectiveness Result - 7
Rehabilitation Routing Scale (RRS)	3	3	0
Rehabilitation potential (RP)	average	average	

Discussion

In this study, we evaluated the early clinical outcomes of transverse SSO with cementless THA using a derotational plate in a patient with high hip dislocation.

Dysplasia of the hip joint can be attributed as one of the causes of secondary coxarthrosis [10, 11]. When treating Crowe type IV DDH, special attention is given to the degree of femoral head displacement, as it is considered a complex type [12]. The primary surgical goal is to restore joint biomechanics, reduce the femoral head into the true acetabulum, achieve lower limb length equality, and ensure stability of the prosthesis components. According to several authors, the preferred method for treating such patients remains the combination of THA with transverse SSO, which has shown good results. However, this method presents technical challenges for surgeons [13, 14]. Risks associated with this procedure include traction neuropathy of the sciatic nerve, intraoperative femoral fractures, limb lengthening discrepancies, spatial mismatch of prosthesis components leading to early instability, and formation of a pseudoarthrosis [15]. In literature, authors note that the frequency of non-unions ranges from 2.8% to 11.4%, and intraoperative fractures occur at rates between 5.2% and 26.8% [9, 16-18].

There are several types of SSO [19]; however, many authors prefer the transverse type because it requires less specialized preparation and is technically easier compared to others. Despite this, the most common complication associated with this type is non-union of the osteotomy zone, which can be attributed to incomplete contact of the osteotomized bone surfaces, mismatch in diameters between the proximal and distal fragments, and rotational instability at the osteotomy site [19, 20]. There is no consensus on the fixation of the osteotomy zone: some authors prefer not to fix this area, believing that the stem of the prosthesis provides sufficient stability, while others advocate for additional fixation methods such as bone wedges, wire cerclage, and plate with screws [21].

The use of bone graft as fixation for the osteotomy site allows correction of anteversion, provides rotational stability, and eliminates the need for additional osteosynthesis regardless of the prosthesis stem design [19, 22]. However, a drawback of this method is its limited application, difficulty in implantation, graft lysis, rejection, and infection, which may necessitate reoperation. The use of cables and wires does not provide stable fixation of the osteotomy site and can lead to subsequent fragment rotation, osteolytic changes in bone tissue, polyethylene wear, and development of infectious complications [21, 23]. Biomechanical studies comparing methods of femoral fixation with a prosthesis stem show that fixation with a plate and screws at the fracture site surpasses cable fixation [10]. However, technical challenges arise when performing osteosynthesis of the distal and proximal fragments due to the presence of the prosthesis stem in the femoral canal, as these plates are not designed for bone synthesis in the presence of a prosthesis stem. The holes and screw direction in the plates are perpendicular to the prosthesis stem, preventing fixation of the second cortex of the plate. Therefore, longer plates are used to enhance stability, which increases the size of the construct, widens the surgical incision, lengthens the operation time, increases blood loss, soft tissue trauma, intraoperative fractures, and delays wound healing.

In our case, we used our developed locking plate, which allows eliminating rotational mobility of the osteotomized femoral fragments and bypassing the prosthesis stem by placing screws in the sagittal direction.

Despite the short observation period, we achieved good early postoperative results. Within 6 months after the operation, we demonstrated complete consolidation of the osteotomy site. However, considering the patient's bilateral hip joint involvement, the left lower limb lengthened by 4 cm, and surgical treatment for the second hip joint has been proposed to the patient. But due to family circumstances, the patient refrained from the proposed second surgery.

Despite the positive results, our case has several limitations due to the short observation period and a small number of cases. Further research is planned.

Conclusions

Total hip arthroplasty (THA) for Crowe type IV dysplastic coxarthrosis falls into the category of complex joint replacement surgeries, requiring thorough preoperative assessment and planning using modern diagnostic methods. The choice of osteotomy and fixation methods significantly influences treatment outcomes, helping to avoid complications, reduce rehabilitation times, and improve patients' quality of lifeю

Author Contributions: The author's contribution. Conceptualization and methodology - O.D. and B.G.; surgery - A.K.; assisting in surgery and management - O.D., A.E. and B.A.; questionnaire data processing - A.M. and B.G.; writing - preparation of the initial draft - O.D.; writing – reviewing and editing - B.G., A.K. and A.M.

All the authors have read and agreed with the published version of the manuscript.

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Institutional Review Board Statement: This case was approved by the local ethics committee of our National Research Center of Traumatology and Orthopedics named after Academician Batpenov N.D., dated November 9, 2022, and No. 4 in accordance with the Helsinki Declaration. Informed consent to participate was obtained from the patient prior to inclusion in the study.

Informed Consent Statement: Written informed consent for publication of this clinical case and any accompanying images was obtained from the patient. A copy of the written consent is available for review.

Data Availability Statement: All data are included in the "Case Presentation" section and are available from the corresponding author upon reasonable request.

All the authors have read and agreed with the published version of the manuscript.

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Conflicts of Interest: The authors declare that they have no competing interests.

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Октяброва Д. [1], Ашимов Қ. [2], Berk Guclu [3], Абильмажинов М. [4], Сулейменов Б. [5], Байдалин Т. [6], Бекназаров А. [6], Ағабеков Е. [7]

[1] Травматолог-ортопед дәрігер, Академик Н.Д. Батпенов атындағы Ұлттық травматология және ортопедия ғылыми орталығы, Астана, Қазақстан. E-mail: oktyabrovadana@gmail.com

[2] №3 ортопедия бөлімшесінің меңгерушісі, Академик Н.Д. Батпенов атындағы Ұлттық травматология және ортопедия ғылыми орталығы, Астана, Қазақстан. E-mail: kairat_ashimov@mail.ru

[3] Травматология және ортопедия кафедрасының меңгерушісі, Уфук университеті, Анкара, Туркия. E-mail: gucluberk@yahoo.com

[4] Травматология және ортопедия кафедрасының меңгерушісі, Астана медицина университеті, Астана, Қазақстан. E-mail: salta_sso@mail.ru

[5] Травматолог-ортопед дәрігер, Академик Н.Д. Батпенов атындағы Ұлттық травматология және ортопедия ғылыми орталығы, Астана, Қазақстан. E-mail: bekjan-suleimen@mail.ru

[6] №7 ортопедия бөлімшесінің меңгерушісі, Академик Н.Д. Батпенов атындағы Ұлттық травматология және ортопедия ғылыми орталығы, Астана, Қазақстан. E-mail: t.baidalin@gmail.com

[7] Травматолог-ортопед дәрігер, Академик Н.Д. Батпенов атындағы Ұлттық травматология және ортопедия ғылыми орталығы, Астана, Қазақстан. E-mail: dr.askar1990@gmail.com

[8] Травматолог-ортопед дәрігер, Академик Н.Д. Батпенов атындағы Ұлттық травматология және ортопедия ғылыми орталығы, Астана, Қазақстан. E-mail: yerdaulet.21@mail.ru

Түйіндеме

Жамбас буынының дисплазиясы – бұл дер кезінде диагноз қойылмаса және емделмесе, жамбас буынының қызметінің бұзылуына әкелетін тірек-қимыл аппаратының ауыр патологиясы. Ол хирургиялық араласуды қажет ететін остеоартритке әкеледі.

Бұл мақалада 6,5 см болатын көлденең ұршықасты қысқарту остеотомиясымен сол жақ жамбас буынының цементсіз толық жамбас артропластикасы жасалған науқастың жағдайды сипатталады.

Клиникалық жағдайдың ерекшелігі – остеотомия аймағында ротациялық және осьтік тұрақтылықты қамтамасыз ететін жаңадан әзірленген пластинаның қолданылуы болды. Пациенттің жағдайы әрі қарай бақылауда және тиісті ем жүргізілуде. Зерттеу мен пациенттің жағдайын қадағалау процесі әлі де жалғасып жатыр.

Түйін сөздер: жамбастың даму дисплазиясы, артропластика, субтрохонтериялық остеотомия.

Тотальное эндопротезирование тазобедренного сустава с подвертельной укорочивающей остеотомией с использованием деротационной пластины: Клинический случай

Октяброва Д. [1], Ашимов К. [2], Berk Guclu [3], Абильмажинов М. [4], Сулейменов Б. [5], Байдалин Т. [6], Бекназаров А. [6], Ағабеков Е. [7]

[1] Врач травматолог-ортопед, Национальный научный центр травматологии и ортопедии им. академика Батпенова Н.Д., Астана, Казахстан. E-mail: oktyabrovadana@gmail.com

[2] Заведующий отделение ортопедии №3, Национальный научный центр травматологии и ортопедии им. академика Батпенова Н.Д., Астана, Казахстан. E-mail: kairat_ashimov@mail.ru

[3] Заведующий кафедры травматологии и ортопедии, Университет Уфук, Анкара, Турция. E-mail: gucluberk@yahoo.com

[4] Заведующий кафедрой травматологии и ортопедии, Медицинский университет Астана, Астана, Казахстан. E-mail: salta_sso@mail.ru

[5] Врач травматолог-ортопед, Национальный научный центр травматологии и ортопедии имени академика Батпенова Н.Д., Астана, Казахстан. E-mail: bekjan-suleimen@mail.ru

[6] Заведующий отделением ортопедии №7, Национальный научный центр травматологии и ортопедии имени академика Н.Д. Батпенова, Астана, Казахстан. E-mail: t.baidalin@gmail.com

[7] Врач травматолог-ортопед, Национальный научный центр травматологии и ортопедии имени академика Батпенова Н.Д., Астана, Казахстан. E-mail: dr.askar1990@gmail.com

[8] Врач травматолог-ортопед, Национальный научный центр травматологии и ортопедии им. академика Батпенова Н.Д., Астана, Казахстан. E-mail: yerdaulet.21@mail.ru

Резюме

Дисплазия тазобедренного сустава - это тяжелая патология опорно-двигательного аппарата, которая при несвоевременной диагностике и лечении приводит к нарушению функции тазобедренного сустава. Оно приводит к остеоартрозу, который требует хирургического вмешательства.

В данном отчете описан случай, когда была выполнена бесцементная тотальная артропластика левого тазобедренного сустава с поперечной субтрохантериальной укорачивающей остеотомией длиной 6,5 см.

Особенностью данного клинического опыта было использование недавно разработанной пластины, обеспечивающей ротационную и осевую стабильность в месте остеотомии. Пациент продолжает наблюдаться и проходит дальнейшее лечение. Стоит отметить, что данное исследование и наблюдение за пациентом продолжается.

Ключевые слова: дисплазия тазобедренного сустава, артропластика, подвертельная остеотомия.