Features of THA in Patients with High Congenital Hip Dislocation

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Abstract

There are a fair number of papers presenting the outcomes of total hip arthroplasty with shortening subtrochanteric osteotomy in high hip dislocation. Generally the authors used long modular stems or Wagner stems. The reports describing the outcomes of such procedures with standard femoral stems are rather rare.

The purpose of this study was to evaluate short-term and medium-term outcomes of total hip arthroplasty with standard femoral stems and shortening subtrochanteric osteotomy for treatment of high hip dislocation.

Materials and Methods. From 2010 to 2016 the authors performed 18 hip arthroplasties with shortening subtrochanteric osteotomy in 16 patients with high hip dislocation. All patients were clinically evaluated using Harris Hip Score and radiography prior to and after the surgery.

Results. The mean Harris Hip Score significantly improved compared to preoperative values from 39.7±1.4 to 84.7±1.6. At mean follow-up of 24±2.4 mounts the authors observed 2 case of nonunion at osteotomy site and 1 case of transient nerve palsy. Revision surgery was performed in 2 patients due to nonunion. The mean limb lengthening was 3.65±0.21 cm.

Conclusion. Total hip arthroplasty with subtrochanteric osteotomy is an effective technique for treatment of Crowe type III-IV congenital hip dislocation with high rate of successful fixation on the typical femoral stem, healing of osteotomy site and satisfactory short- and medium-term clinical outcomes. The non-modular tapered stem provides sufficient stability in distal and proximal parts of the femur. The use of standard tapered stem allows to achieve good healing rates of the osteotomy.

Keyworlds: high hip dislocation, total hip arthroplasty, shortening femoral osteotomy.

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Introduction

Total hip replacement in patients with high congenital hip dislocation is technically a complex procedure while restoration of anatomical and biomechanical center of rotation might lead to overlengthening of the lower limb, hypertension of periarticular tissues, early aseptic instability and sciatic nerve neuropathy [1–9]. Thus, placement of acetabular component into the true acetabulum requires a shortening osteotomy to reduce hypertension of soft tissues, to improve conditions for abductors function and mitigate the risk of neurological complications [3, 5, 10–14]. There are two principal options of shortening femur osteotomy: proximal Paavilainen osteotomy and subtrochanteric osteotomy. There are many evidence of successful application for both methods in the current literature [1, 3, 15–17] and only singular records of distal shortening osteotomy [18, 19]. However, such reconstructive arthroplasty procedures are accompanied by risk of femur non-union at osteotomy site which might require a revision [4, 11, 20–23], besides, time of arthroplastic surgery with shortening osteotomy and volume of intraoperative blood loss are substantially increased as compared to primary joint replacement [8]. The authors of the present paper gave the preference to subtrochanteric shortening femur osteotomy.

Purpose of the study: to evaluate short-term and medium-term outcomes of total hip arthroplasty with shortening subtrochanteric osteotomy for treatment of high hip dislocation.

Material and methods

In the period from 2010 to 2016 16 patients (18 joints) were admitted to the clinic for treatment of high hip dislocation. Inclusion criteria for the study were acetabulum dysplasia of type IV by J.F. Crowe.

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Patients with systemic or local infection as well as with severe somatic diseases were excluded from the study. Mean relative limb shortening (in unilateral dislocation) amounted to 4.93±0.29 cm, min — 3 cm, max — 7 cm. Mean age of operated patients was 45 years (from 25 to 65). The study group included 15 female patients (94.5%) and one male patient (5.5%). The study was approved by ethics committee of "Ilizarov Restorative Traumatology and Orthopaedics Center" and was carried out in accordance with ethical standards stipulated in the Helsinki Declaration (1975 and 2008). Cementless acetabulum and femoral components were used in all cases. R3 cup by Smith&Nephew was implanted in 13 cases, Trilogy cups by Zimmer was implanted in 3 patients. Cerafit cup by Ceraver and EcoFit cup by ImplantCast were used in one case. Bone grafting of acetabulum with massive autograft from femoral head was used during two surgeries (11%) to achieve adequate cup coverage. Acetabulum componenets of small size 44–48 mm were used. SL-Plus tapered stems with rectangular cross-section by Smith&Nephew were prevailing among femoral components and implanted in 13 cases, Alloclassic stem by Zimmer and Dialoc stem by ImplantCast were implanted in three and one case respectively. In one patient the authors used a Cerafit stem by Ceraver. In five cases (27.7%) when the authors failed to gain satisfactory rotational stability additional plating internal fixation was used.

Surgical technique. All procedures were performed with patient in lateral position on a healthy side after careful preoperative planning. A Harding approach with distal extension was used in 15 cases, in three cases a Watson-Jones approach was used. Skin, subcutaneous structures and fascia lata were dissected. Femoral head was dislocated after capsule dissection. Femoral neck osteotomy was performed at the level stipulated by preoperative planning. Small size rasps were used for handling of femoral canal. Elevator was used to mobilize soft tissues distally to the lesser grochanter, then subtrochanteric femur osteotomy followed, proximal femur was abducted to open access to acetabulum.

Hohmann retractors were positioned behind anterior and posterior acetabulum walls. Often the authors observed "wigwam" type acetabulum form with hypoplasia of margins. Several pins were inserted unicortically and control x-ray was taken to identify the true acetabulum. Small size reamers were used to ream the acetabulum. In 84% of cases screws were used for additional fixation of acetabulum.

Prior to osteotomy the authors treated femoral canal using rasps with anteversion of 10–15° to femoral condyles. 3–4 cm distally to the lesser trochanter the periosteum was removed from femur and soft tissues were held back by protective instruments. The level of femur osteotomy was determined during preoperative planning. Mean length of proximal fragment (distance from top of the greater trochanter to the level of osteotomy) was 6.8±0.21 cm. Chisel was used to make longitudinal marks on the surface of the femur to identify rotation. Then followed transverse femur osteotomy with resection of fragment of 2–4.5 cm (2.9±0.2 cm). Afterwards rasp was positioned into the canal of the proximal fragment (Fig. 1a) to measure the length of distal rasp part which should be positioned into the distal fragment (Fig. 1b). To achieve sufficient fixation the authors aimed at positioning of rasp into the distal fragment for depth of 5cm at least. Treatment of the canal in the distal fragment was done by rasp at the required depth considering rotation marking done earlier. Rasp was inserted into the canals of distal and proximal fragments to check rotational stability and contact between the fragments. During test reduction the authors used a minimal size head. In case of failed attempt to bring down and reduce the femur additional resection of distal fragment was performed. Femoral prosthesis component was implanted after achieving stability of the joint with satisfactory range of motion an without hypertension of soft tissues. In five cases (27.7%) plating internal fixation was used when stability of femur fragments fixation was doubtful.

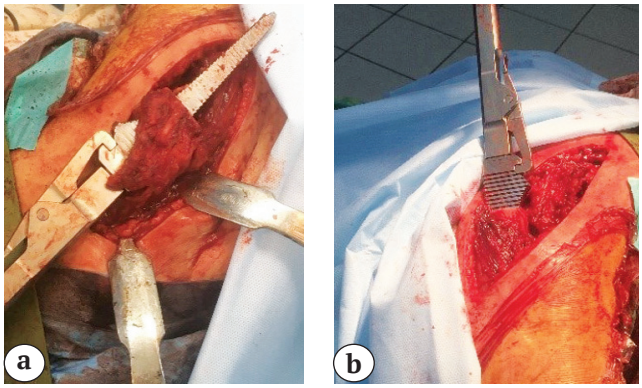

Fig. 1. Stages of surgical technique:
a — handling of proximal femur portion;
b — handling of distal femur portion

Clinical and roentgenological evaluation. All patients were clinically evaluated using Harris Hip Score and radiography prior to and after the surgery. Teleroentgenograms of lower limbs from iliac wings to ankle joints were made in 14 cases. Computer tomography was made in 10 patients prior to surgery when it was required to visualize space interrelations in the hip joint and to assess bone deficit in the true acetabulum. Roentgenological evaluation was made for positioning of prosthesis components, consolidation rate of femur fragments. X-rays with 1.0 focus were used to determine caudal displacement of rotation center and offset increase. Limb lengthening af-

ter the surgery was clinically evaluated and controlled by teleroentgenoram.

18 surgery outcomes (100% of cases) were followed up for the period of 8 to 48 months, mean FU period was 24±2.4 months. Statistical processing was done using Microsoft EXCEL 2010 and included descriptive statistics: mean value (M) and error of mean (m). Value differences were considered statistically significant with $p \leq 0.05$.

Results

Time of surgery was 209±14 minutes (from 90 to 275 minutes). Average intraoperative blood loss volume was 734±49 ml (from 300 to 1100 ml). Preoperative Harris scores averaged 3.7±1.4 points where min was 27.3 and max — 48 points. Healing of femur fragments at the osteotomy site was evaluated clinically and roentgenologically and was achieved in average of 7 months (from 5 to 8 months). Two patients (11%) were an exception with no healing achieved which required revision with plating internal fixation and bone allografting.

Mean hospital stay was 22.9±1.5 days (from 14 to 50 days). Relatively long hospital stay is due to irregular pattern of clinical cases and need for additional examinations prior to surgery.

Postoperative relative length of the lower limb increased at 3.65±0.21 cm, min — 2 cm, max — 5.1 cm. Greater trochanter was displaced caudally in average at 5.97±0.46 cm (from 3.3 to 8.6 cm). Offset increased at 7.8±0.9 mm (from 2 to 13 mm). Mean Harris Hip score was significantly different from the benchmark ($p<0.001$) and was 84.7±1.6 points (from 73 to 90 points). Good and excellent outcomes (Harris Hip Score above 80 points) were reported in 15 cases (83.3%). Harris Hip Score in patients with nonunion of femur fragments was 68.5 and 64 points which corresponded to poor outcome (less than 70 points). The final treatment outcome was considered as satisfactory (less than 80 points) in three cases, including two patients with nonunion of femur at the osteotomy site.

Below x-rays demonstrate outcomes of hip replacement with subtrochanteric osteotomy in a female patient with high hip dislocation (Fig. 2).

Complications and revisions. Intraoperative distal fragment fracture during stem insertion was reported in one case. Cerclage wires were used for fracture fixation with following consolidation.

One female patient with postoperative limb lengthening of 4.5 cm complained of pain upon out foot and tibia surfaces. Movement function was intact. The patient underwent therapy at a specialized department by courses of neurotropic medication and insertion of temporary epineural electrodes to resolve traction neuropathy of peroneal portion of sciatic nerve. No motor and sensor deficit was reported during control examination in 8 months after the surgery.

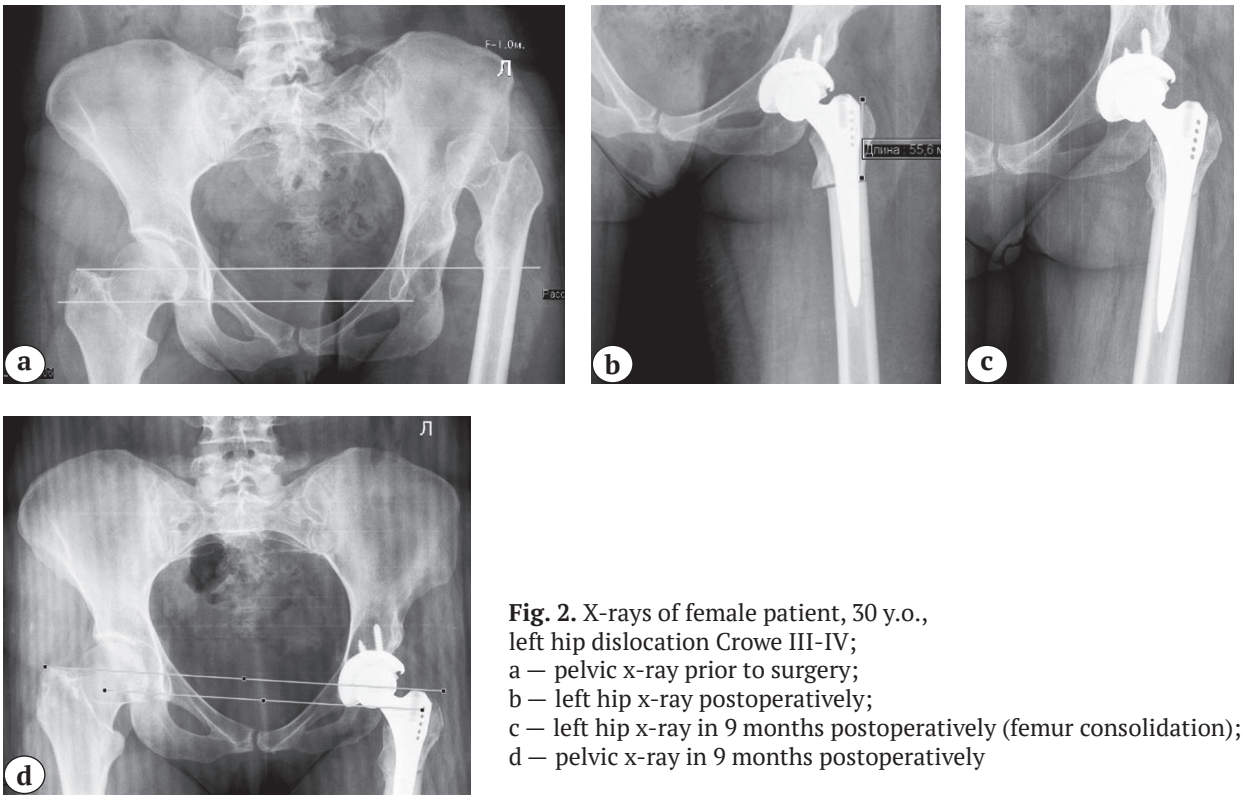

Fig. 2. X-rays of female patient, 30 y.o.,
left hip dislocation Crowe III-IV;
a — pelvic x-ray prior to surgery;
b — left hip x-ray postoperatively;
c — left hip x-ray in 9 months postoperatively (femur consolidation);
d — pelvic x-ray in 9 months postoperatively

Nonunion of femur fragments at the osteotomy site was reported in two patients who complained of pain in upper third of the femur during movements. In both cases no consolidation between proximal and distal fragments was observed. However, no absolute signs of aseptic stem instability in relation to distal femur fragment were observed on x-rays and during revision. During revision plating internal fixation of proximal and distal femur fragments with bone allograft was performed (Fig. 3).

No cases of deep vein thrombosis, periprosthetic infection and polyethelene wear were reported in the study group.

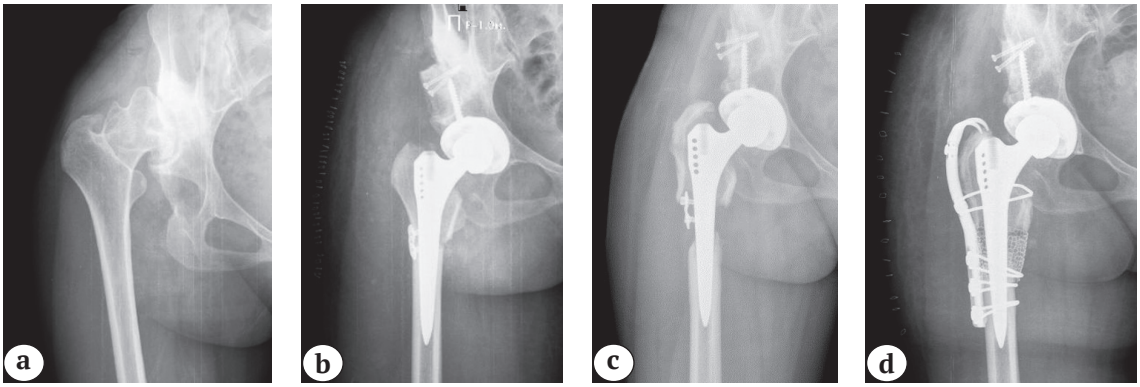

Fig. 3. X-rays of female patient, 44 y.o., left hip dislocation;
a — prior to surgery;
b — after replacement with additional fixation by 8-type plate;
c — non healing and displacement of fragments 1 year postoperatively;
d — after revision surgery and fixation by Accord system with bone grafting

Discussion

The majority of authors agree that after subtrochanteric shortening osteotomy during arthroplasty in patients with high hip dislocation the stem should play a role of "intramedullary nail" [5, 23–25]. At the same time the following methods are used to increase stability of fixation for fragments after osteotomy: long and/or modular stems [5, 11, 20, 26, 27], cable systems and cerclage [11, 20, 28], various plating systems [4, 8, 11, 22, 23], bone auto- and allografts [4, 20, 26] as well as combination of above methods [4, 8 11, 20].

In the majority of publications the researchers report consolidation at osteotomy site within the period from 12 weeks up to 1 year [4, 6–8, 22, 24, 26, 27, 29]. However, the nonunion rate was rather high. A common opinion is that late consolidation and pseudoarthrosis formation is the widespread complication after such procedures [4, 8, 11, 20, 21, 29]. The authors of the present study report the rate of pseudoarthrosis formation at the osteotomy site as 11.1%. This value correlates to values of femur fragments nonunion and survivorship of femoral components of prosthesis reported in the current literature (Table).

M.-S. Park performed arthroplasty using modular femur components, standard tapers distally fixed stems combined with autograft and plates. The author notes that in cases of nonunion standard tapered stems were inserted [11].

In the publication of K. Oinuma et al. modular components (S-ROM) were preferred and the paper presents 100% survivorship data at 3.7 years follow up [27]. Orthopaedic surgeons from China used Wagner stem in their practice during hip arthroplasty in 21 patients with high hip dislocation. The following complications were described: dislocation, nonunion of femur fragments which required replacement of the stem and three neuropathies. All complications were observed within first year postoperatively [28].

In publication on a series of 73 arthroplasties with subtrochanteric shortening osteotomy H. Sofu reports six revised tapered stems. The reasons for revision were absence of consolidation, deep periprosthetic infection and recurrent dislocation [22].

Many orthopaedic surgeons place an emphasis on the technique of end surfaces treatment by making oblique or step-cut osteotomy considering this as determining factor for time of fragments consolidation and successful outcome of treatment in general [8, 20, 22, 24–26, 29]. However, performance of oblique and step-cut osteotomies is rather laborious and increases intraoperative blood loss and time of procedure [22]. F. Yildiz et al. did not observe any statistically significant difference in experimental study between different types of subtrochanteric osteotomies under axial and rotational load [30].

Table

THA outcomes in patients with high hip dislocation using subtrochanteric shortening osteotomy (literature data)

Authors	FU period (years)	Number (cases) of operated joints	Survivorship of femoral components, %	HHS prior to surgery	HHS after surgery	Length of resected femur segment, cm
D. Becker, R.B. Gustilo, 1995	2.6	7	86			4.5
W. Bruce et al., 2000	4.5	9	89	31	81	1.7
N. Senerc et al., 2002	4	28	93			3.2
J. Masonis et al., 2003	5.8	21	91	32.5	73.6	3.8
B. Erdemli et al., 2005	5	25	96	37.8	95	4.2
M.-S.Park et al., 2007	4.8	24	87.5	35.4	81.6	3.4
N. Yalcin et al., 2010	6	44	88.5	36.2	81.2	
Ö. Kılıçoğlu et al., 2013	6.8	20	90	33	83	4.5
K. Oinuma et al., 2014	3.7	12	100			2.5
H. Sofu et al., 2015	4.8	73	87	38.6	83.7	3.5
H. Akiyama et al., 2011	5	15	80			3.8
J. Zhu et al., 2015	3.5	21	95	52	90	1.5
M. Ollivier et al., 2016	10	28	89	43	87	4
Mean	5.1±0.35	25.1±3	90.1±1	37.7±1.2	84.3±1.3	3.4±1.9

Limitations. Follow up period is short which does not allow to make a conclusion on long-term survivorship of prosthesis components. However, some authors [21] think that in case of no early complications such as nonunion at osteotomy site or hip dislocation there is a low risk of other complications manifestation during first 10 years postoperatively. The authors of the present paper plan to report analysis of late outcomes in next publications.

Conclusion

Cementless hip replacement where cup is placed in the true acetabulum along with subtrochanteric shortening osteotomy is the efficient treatment for patients with high hip dislocation. However, such surgical tactics features a relatively high rate of nonunion of femur fragments which deteriorates treatment outcomes and requires revision. Obtained results allow the authors of the present paper to conclude that use of tapered stems with rectangular cross-section gives good outcomes in short- and medium-term follow up period. In cases of doubt regarding stability of femur fragments as well as femoral stem fixation it's advisable to use a plating internal fixation.

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