

## Complications of palliative interventions for hip dislocation in patients with cerebral palsy

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**Introduction** Hip dislocation is one of the most severe orthopedic complications among the problems in patients above 10 years of age with severe forms of cerebral palsy (CP), when reconstructive intervention is impossible. The purposes of palliative surgical orthopedic treatment in patients of this category consist in elimination or reduction of the pain syndrome, as well as elimination of the hip faulty position, possibility of limb free mobilization, improving the patient's care conditions. Proximal femoral resection arthroplasty and valgus support osteotomy of the proximal femur combined with head resection are the main methods of palliative surgical treatment. **Purpose** To evaluate the encountered errors and complications, as well as to compare the authors' own observations with the literature data. **Materials and Methods** The authors analyzed the complications encountered in the process of palliative surgical treatment (37 surgeries) of the hip dislocation in 22 patients which represented severe forms of motor disorders for spastic CP forms. Level V by GMFCS was observed in nine (9) cases, Level IV – in 13 cases. Proximal arthroplastic resection was performed in 11 cases (Group 1), proximal valgus support osteotomy – in 26 cases. **Results** The authors observed five (5) complications in Group 1 after 11 interventions (45.5 %). Correction of the developed complications led to the full achievement of the desired result of treatment in five of six patients from this group (83.3 %): disappearance or significant reduction of the pain syndrome, ease of hygiene, a comfortable sitting position. In Group 2 where the purpose of treatment aside from the pain syndrome elimination, the increase in the range of passive hip mobilization and achieving the proper postural management consisted in creating the conditions for passive verticalization with the lower limb support, seven (7) complications occurred after 26 interventions (26.9 %). The proper result of treatment was achieved in 24 of 26 hips after surgical correction of the complications (92.3 %). **Conclusion** In most cases, surgical intervention is required in order to eliminate the complications after the palliative intervention, that allows, in general, achieving the desired result of treatment. When the severe pain syndrome develops due to mechanical conflict between the hip and pelvic bones through heterotopic ossifications and marked periosteal stratifications, the femoral arthroplastic resection after palliative interventions allows controlling the pain syndrome, restoring the hip passive mobility, providing postural management, but not to impart weight-bearing to the limb. It's necessary to use only the plates with angular stability and without placing the screws in the direction of the acetabulum.

**Keywords** Cerebral palsy, hip dislocation, palliative surgery, complications

### INTRODUCTION

Hip dislocation is the most common and severe complication in children with spastic forms of cerebral palsy (CP) that are referred to levels IV and V of motor disorders (GMFCS IV, V) that is encountered in 30-63 % of cases [1-4]. In children with motor disorders that are older than 10 years of age and have GMFCS levels IV and V, reconstructive operations by hip dislocation are considered unsuitable in most cases due to severe deformities of the femoral head and acetabulum that are accompanied by a subtotal loss of the articular cartilage [1, 5-7]. In a complex of problems that are present by severe CP in patients older than 10 years, hip dislocation is the main cause of impaired quality of life that limits the initial modest functional

capabilities in both children and adults [2, 8, 9].

According to the literature, the aims of palliative surgical orthopaedic treatment in this group of patients are elimination or reduction of pain [10-16], elimination of femur malposition, possible free limb mobilization [10, 11, 17-20], improvement of patient's care including the hygiene of the perineum [10, 11, 17, 18]. The main methods of palliative surgical treatment are proximal femoral resection arthroplasty [19, 20] and valgus osteotomy of the proximal femur either in combination with resection of the head or without it [7, 12, 13, 21].

The purpose of this study was assessment of errors and complications encountered and comparison of our own observations with the literature data.

### MATERIALS AND METHODS

This research is based on the study of errors and complications that were encountered by palliative surgical treatment of hip dislocation in 22 patients that had severe motor disorders due to spastic CP. Nine patients had GMFCS level V and 13 cases were of level IV.

Orthopaedic complications of CP in the lower limbs were a neglected hip dislocation (16 bilateral cases and 5 unilateral ones). These changes were associated with marked pain (higher than level 3 according to the Face Pain Scale [22])

by hip movements, in a sitting position, by doing everyday hygiene in all the cases including during rest in 20 patients.

Moreover, the indications to palliative interventions were also serious difficulties by performing personal hygiene in the groin due to flexion adduction of the femurs (21 cases). Postural management was extremely difficult in all the patients. Passive verticalization with support on the lower limbs was completely impossible. Trophic changes in the area of greater trochanters and femoral condyles due to

being in one and the same posture were observed in 9 cases.

In total, there were 37 palliative interventions in these 22 patients. Surgeries were consequently performed with a break of 4 weeks to 2 months if hip dislocation was bilateral. Operative palliative interventions were done with the use of two methods: resection arthroplasty of the proximal femur (group 1) or vagus osteotomy in the proximal femur (group 2).

The first method is resection of the proximal femur and stamping of the quadriceps portions over the saw line of the distal fragment of the femur and suturing of m. iliopsoas, joint capsule, musculus gluteus medius and minimus over the acetabulum for excluding a direct contact between the pelvic bones and femoral diaphysis (**Fig. 1a**) [16, 25]. This method was used in six children (11 joints) of group 1 (GMFCS V): bilateral in five cases and a unilateral resection on one side combined with a support osteotomy on the contralateral side in one case.

Support osteotomy of the proximal femur was performed in 17 patients (26 interventions). This included a classical operation of McHale [17] on 15 joints, that is resection of the head and neck of the femur and a subtrochanteric valgus osteotomy (valgus angle of  $45^\circ$ ), (**Fig. 1b**). Osteosynthesis in these patients was performed with a LCP Synthes 3.5 plate with a changed angle up to  $180^\circ$ . The remaining 11 interventions were performed with the use of our own modified proximal support osteotomy (**Fig. 1c**). This intervention includes the resection of the head and neck of the femur but the angle of

turning was  $90-110^\circ$  in such a way that the smaller trochanter was the most high part of the proximal femur that was plunged into the acetabulum. Osteosynthesis was performed also with a plate with an angular stability and the proximal screw was positioned at the right angle to the diaphyseal part of the plate (Metis Ltd, Russia).

Moreover, triple arthrodesis of the foot (24 feet), correction of hallux valgus (14 cases) by a reconstructive intervention or arthrodesis of the 1st metatarsophalangeal joint were performed simultaneously with hip joint surgery with the aim to correct associated deformities and pathological malposition of the tibia and foot. Flexion contracture of the tibia was eliminated with supracondylar extension osteotomy of the femur along with bringing the patella down and lengthening of the knee joint flexors (24 joints). Knee joint extension was achieved by lengthening of the posterior muscle group of the femur and bringing the patella down in 7 patients.

Surgical errors and complications in this group of patients were assessed not only in inpatient settings but also at follow-ups that were not less than one year. Besides, invasiveness of the surgery was assessed by blood loss values during the first 2 days.

The quantitative findings were statistically processed using Microsoft Excel 2016 software. Statistical study included the descriptive statistics: means (M) and standard deviations ( $\delta$ ). The difference of values was defined using a disperse analysis for independent samples. The difference was considered statistically significant by  $p \leq 0.05$ .



**Fig. 1** AP pelvic radiographs. Types of palliative interventions in hip joints: Resection arthroplasty of the proximal femur (a). Subtrochanteric valgus osteotomy with resection of the femoral head (b). Modification of support osteotomy of the femur with resection of the femoral head (c)

## RESULTS

Blood loss and dynamics of general blood count in the postoperative period was similar in groups 1 and 2 (**Table 1**). Erythrocytes mass transfusion was performed in four cases in group 1 and in 8 cases in group 2. Blood loss values were  $161.1 \pm 65.09$  ml in group 1 and in the group of valgus support osteotomy of the proximal femur –  $159.1 \pm 39.5$  ml.

Complications, their consequences and correction methods in group 1 are given in **Table 2**. We observed 5 complications after 11 interventions in this group (45.5 %).

It should be noted that correction of complications resulted in a complete achievement of the results planned in 5 out of 6 patients of this group (83.3 %): elimination or considerable reduction of pain, more comfort for doing

hygiene and sitting position.

In group 2 (**Table 3**) where the treatment was aimed not only at elimination of pain, increase in passive femur motion range and full postural management but also at creation of conditions for passive vertical positioning with support on lower limbs, we met 7 complications after 26 interventions (26.9 %). Two of the cases had two complications each.

It should be noted that despite the management of problems in this group, the planned result was achieved partially in 2 cases, the femur remained not supportive. It should be pointed out separately that there appears a mechanical conflict between the screws of the proximal part of the plate and pelvic bones, even in case the screw length was optimal initially. We

explain the phenomenon by remodeling of the proximal femur (**Fig. 4**). It is important to note that by the performance of our own osteotomy support technique with the use of plates that have the proximal screw at the right angle to the diaphyseal part we did not observe such a complication in any patient as far as the screws are not oriented in the direction of pelvic

bones and the risk of screw threaded portion being beyond the bone by its remodeling is excluded.

Finally we should note that there were only three cases of superficial bed sores in the entire series of these patients (8.1 %) in the gluteus and sacral areas that were cured with local methods.

Table 1

Dynamics of blood counts (numbers of erythrocytes and hemoglobin)\*

	Before operation		First day		Second day	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Erythrocytes; $\times 10^{12}/\text{ml}$	$5.2 \pm 0.6$ (4.22–6.12)	$4.6 \pm 0.3$ (4.25–5.22)	$4.0 \pm 0.7$ (2.68–5.06)	$3.7 \pm 0.6$ (2.44–4.96)	$4.1 \pm 0.6$ (3.33–4.97)	$3.8 \pm 0.5$ (2.7–5.19)
Hemoglobin; g/l	$138.0 \pm 13.9$ (112–161)	$135.1 \pm 11.5$ (115–158)	$107.6 \pm 19.8$ (75–132)	$101.4 \pm 20.2$ (70–149)	$107.4 \pm 10.4$ (98–124)	$109.0 \pm 16.2$ (85–138)

Note: \* minimum and maximum values in parenthesis

Table 2

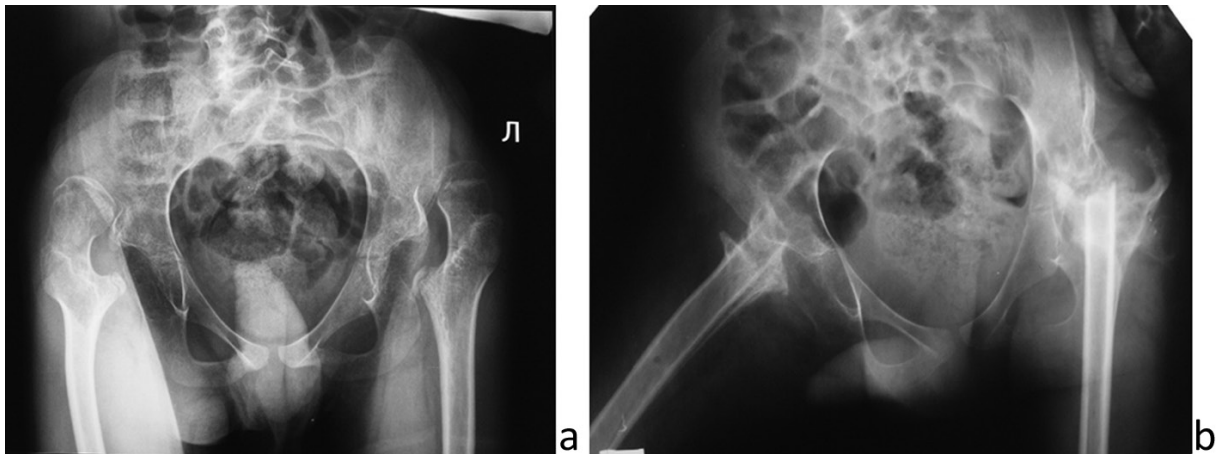
Complications in the group of resection arthroplasty of the proximal femur

Patient	Complication	Cause	Treatment	Outcome
Zh.	Marked periosteal ossification of both femurs that resulted in pain (Level 6) and malposition ( <b>Fig. 2</b> )	Early intensive mobilization of femurs, absent postural management	Postural management, prolonged analgesia and sedation	Femur stiffness in a favorable position as compared with the initial one (improvement of conditions for hygiene and passive sitting)
O.	Marked blood loss (hemoglobin lower than 70 g/l)	Recurrence of bleeding to the end of the second day postoperatively (hemoglobin less than 70 g/l after surgery)	Repeated transfusion of erythrocyte mass, hemostatic therapy	Objectives of treatment achieved
Zh.	Divergence of wound edges after adductotomy	Possible extensive adductotomy	Local	Wound healing by secondary intention
S.	Wire migration in the foot after simultaneous triple arthrodesis (2 months after the operation) that resulted in pain	Expressed osteoporosis in foot bones	Wire removal after local anesthesia	Objectives of treatment achieved
S.	Pain caused by a direct contact between the femur and acetabulum bottom	Violation of the principles of resection arthroplasty – stamping of muscles over the saw line of the femur and acetabulum	Repeated resection with soft tissue plasty	Objectives of treatment achieved

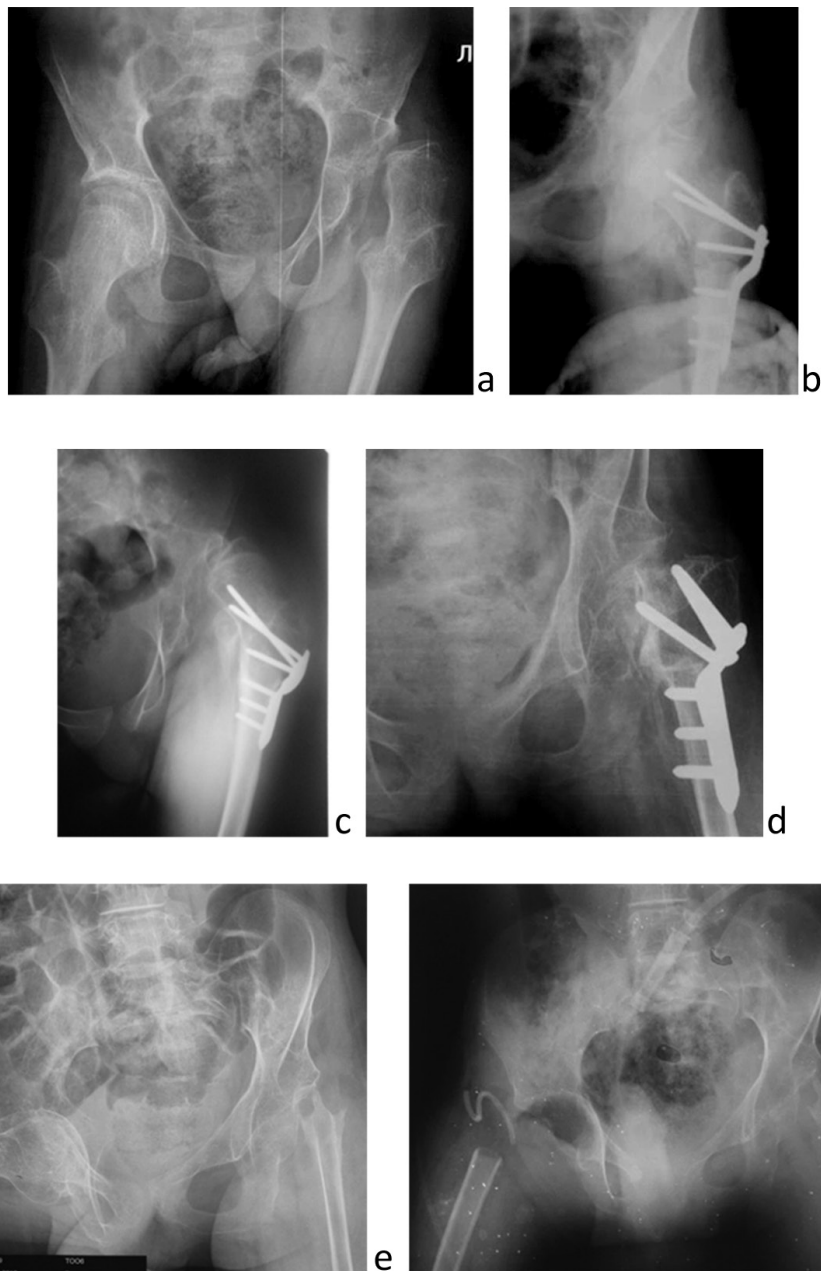
Table 3

Complications in the group of support osteotomy of the proximal femur

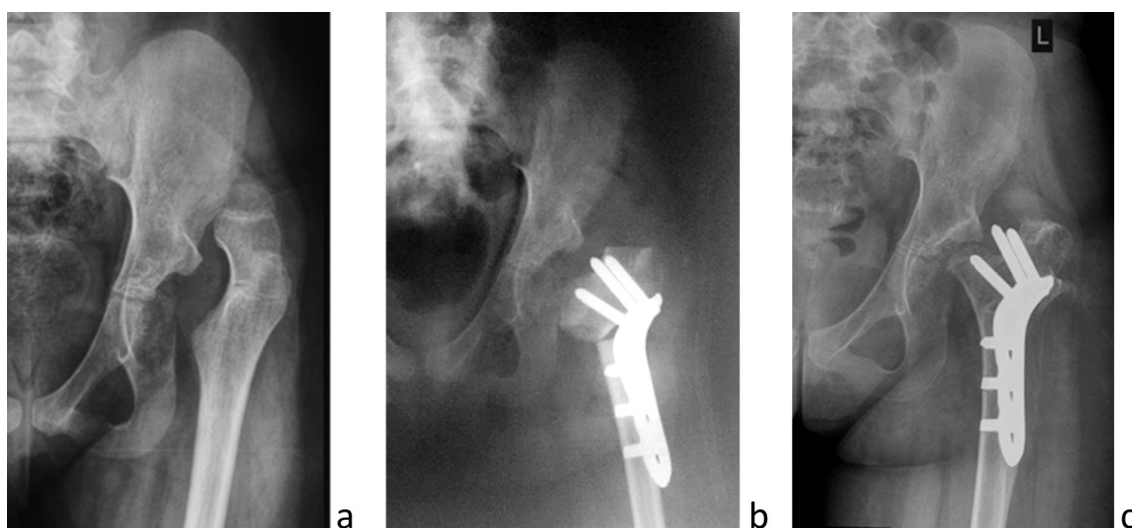
Patient	Complication	Cause	Treatment	Outcome
E.	Pain caused by contact of the screws of the femur with the acetabulum	Use of improper screw length	Removal of plate and screws after bone consolidation	Objectives of treatment achieved
Ch.	Pain caused by heterotopic and periosteal outgrowth, insufficient angle of valgus, and as a result by mechanical conflict between the femur and pelvic bones	Support osteotomy after reconstructive treatment in a 15-year old (operation not due to indications) and insufficient valgus amount ( <b>Fig. 3</b> )	Resection arthroplasty of the proximal femur	Femur mobility, pain elimination, limb not supportive
Tim.	1) Pain caused by contact of the screws of the femur with the acetabulum ( <b>Fig. 4</b> ); 2) Fracture of the proximal femur by removal of osteosynthesis plate	1) remodeling of the proximal femur at long term; 2) osteoporosis	Change of screws for shorter ones	Objectives of treatment achieved
T.	1) Positioning of the lower limb in external torsion $80^\circ$ ; 2) aseptic osteolysis of the smaller trochanter, proximal shift of the femur ( <b>Fig. 5</b> )	Incorrect osteosynthesis	Detorsion osteotomy, change of the plate	Elimination of torsion, proximal migration of femur, limb not supportive
Tit.	Position of the smaller trochanter in the area of the foramen (foramen “dislocation” of the smaller trochanter) that resulted in limitation of passive movements of the femur	Insufficient release of soft tissues and incomplete capsulotomy by performing the intervention	Long-term immobilization in A-shaped plaster cast: spontaneous shift of the smaller trochanter into the acetabulum during 2 months after surgery	Objectives of treatment achieved



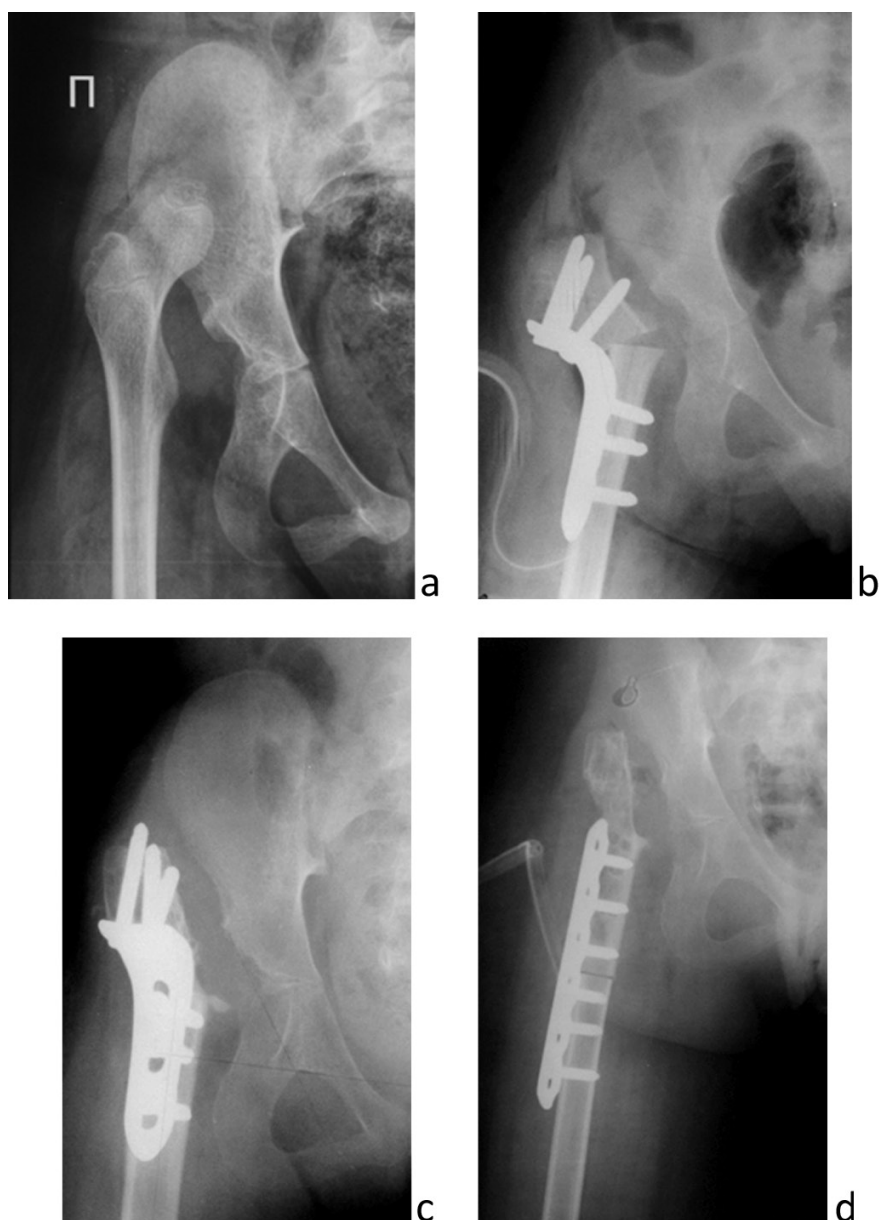
**Fig. 2** AP radiographs of patient Zh's pelvis: Before treatment (a). Marked periosteal and paraosseous ossification one year after treatment (b)



**Fig. 3** AP radiographs of patient Ch's pelvis : Before operation at 15 years of age (a). An attempt to reconstructive surgery (tactical error) (b). Femur subluxation in the early postoperative period (c). An attempt of valgus support osteotomy with head and neck, extensive periosteal response and heterotopic ossification, part of the femoral neck remains coaxial with the diaphysis (d). 9 months after resection arthroplasty on the left side, acetabulum protrusion developed on the right (e). After resection arthroplasty of the right femur (f)



**Fig. 4** AP radiographs of patient Tim's left hip joint: Femore surgery (a). On surgery day (b). 1.5 years after the surgery, reduction of the transverse size of the proximal bone part with 2 screws directed into the acetabulum edge (c)



**Fig. 5** AP radiographs of patient T's right hip joint: Before surgery (a). Valgus support osteotomy of the femur (b). 6 months after, lysis of the smaller trochanter accompanied by proximal migration of the femur and marked external rotation (c). Following retorsion osteotomy and plate change, proximal migration of the femur (d)

## DISCUSSION

Frequency of complications by palliative operations for hip dislocation in adolescents and adults with severe CP types ranges between 18 % [13] and 62.5 % [23]. When the techniques of palliative interventions (resection arthroplasty and valgus support osteotomy) are compared with regard to complications, the opinions differ. Hweang et al [24] who had the total incidence of complications of 32.4 % in a series of 37 patients pointed to the preference of resection arthroplasty as a surgery with a lesser rate of postoperative complications. On the other hand, Leet et al [25] found a considerably lower incidence of the proximal migration of the femur (and associated with this pain) as well as of surgical complications following the McHale valgus osteotomy as compared with the resection arthroplasty. And finally, Wright [26] did not find the difference between the techniques, and noted good and excellent outcomes in 67 % of cases for both techniques by repeated unplanned interventions in 24 % for elimination of complications. In group 1 of our series (resection arthroplasty) good outcomes were achieved in 83.3 % of cases with the frequency of repeated interventions of 18.2 % (two cases). Among these, a repeated intervention in the hip joint was performed in one case that was caused by the defect in the implementation of the initial surgery.

In group 2, the complication rate was 26.9 % (seven complications after 26 interventions) that required 4 unplanned surgeries in 15.3 % of cases that achieved treatment objectives (absent pain, mobility, and support) in 92.3 % of the limbs.

An excessive periosteal response and heterotopic ossification that lead to a mechanical conflict and marked pain are a specific complication of palliative operations, more frequently noted after resection arthroplasty. Abu-Rajad et al [27] observed this in one case after 21 resections, Widmann et al [28] – in two cases out of 18, and Albinana et al [17] – in one out of 8 that required long time traction and indometacin administration. We found only one case in the literature in which the periosteal response after McHale valgus osteotomy resulted in severe pain and required resection of the proximal femur [7]. In two other series, the periosteal response is considered as a part of osteogenesis, is not accompanied by heterotopic ossification and is not considered to be a reason of remaining or developing pain [12, 13, 23, 25]. Our series manifests a high risk of periosteal response that could explain pain after resection arthroplasty (18.2 %). Pain and mobility limitation after valgus osteotomy can be explained by both an insufficient

turning of the proximal fragment (a case of our series) and by retained femoral head after the Schanz palliative operation [13]. In both situations the problem was solved with resection arthroplasty associated with an inevitable loss of limb support.

Osteotomy performance and osteosynthesis both have potential complications associated with an operation technique and implant quality. Hogan [23] and Van Riet [7] stressed that instability of the osteosynthesis performed with plates without an angular stability is frequent – up to 5.6 % of cases. It results in the loss of the proximal femur configuration, proximal migration and insupportive limb [7]. Fuck et al [29] recommended to use only the plates with an angular stability by performing corrective osteotomies in children with neuroorthopaedic pathology. It allows for exclusion of external immobilization even by osteoporosis, enables to start passive joint mobilization during the first week and pass to partial axial loading. We used the plates with a locking screw and therefore completely avoided the problems associated with osteosynthesis instability.

The other problem that is associated with the performance of valgus osteotomy is the excessive screw length that causes the mechanical conflict and pain [7]. As in our series, the removal of the osteosynthesis material (complete or partial) solves the problem. The use of the plates with the proximal screw position at the right angle relative to the diaphyseal part enabled to avoid the risk of this complication even after proximal femur remodeling in our series. However, the femoral fracture at the level of the distal screw required to perform resection arthroplasty of the femur with a consequence of inevitable loss of the support function [7].

General surgical complications, both according to our observations and literature data, are rare in this category of patients when planned operations are performed: 4 cases of superficial bedsores in a series of 18 patients [28], one deep bed sore in a group of 8 patients that required surgical treatment [17], and 3 superficial bedsores in our series.

We should also name a number of complications that we did not observe in our study but were reported by literature: fibrous ankylosis after valgus osteotomy due to a prolonged immobilization of limbs [7], deep venous thrombosis, gastrorrhagia in the early postoperative period [20], death of 2 patients on days 4 and 11 postoperatively (presumably due to acute gastric ulcer and bleeding) [20].

## CONCLUSIONS

Surgical complications after palliative interventions are not rare occasions. In most cases, additional interventions are needed for their elimination that result in the achievement of the required outcome.

If severe pain develops that is caused by the mechanical conflict between the femur and pelvic bones by the presence of heterotopic ossification and expressed periosteal layers, resection arthroplasty of the proximal femur (repeated or

primary following a complicated valgus osteotomy) after palliative interventions enables to control pain, restore passive mobility of the femur and provide postural management in a sitting position but does not provide limb support.

Osteosynthesis by performing palliative osteotomies for achieving support should be done with the use of a plate with an angular stability only and without positioning of the screws in the direction of the acetabulum.

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