

## ***Total hip revision in patients with isolated aseptic loosening of the acetabular component***

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**Introduction** Aseptic loosening of the acetabular component is one of the most common late complications of total hip arthroplasty. Current principles of its treatment consist in replacement of the loosened cup and of the head-and-liner friction couple. There is no unified opinion regarding the stem if it is stable and well-aligned. **Methods** We have analyzed examination and treatment results of 16 patients with isolated aseptic loosening of the acetabular component that underwent total revision. The results of treatment were assessed using the Harris Hip Score and Oxford Hip Score questionnaires on the 10th postoperative day, and then at follow-ups after three, six and 12 months. **Results** The average duration of the operation was 132.5 [115; 150] minutes. Intraoperative blood loss ranged from 600 to 2500 ml and averaged 900 ml [750; 1450]. Analysis of hematological parameters (RBC, HGB, HCT) showed moderate anemia in 14 patients (87.5 %) and only two patients (12.5 %) had mild anemia on the 10th postoperative day. The mean volume of erythrocyte mass transfusion was 450 ml [300; 775]. The final results of treatment were assessed as fair with Harris Hip Score after 12 months. The Oxford Hip Score results of treatment were in the range from 30 to 39 points after 12 months that confirmed the need for additional conservative measures for hip joint stability. **Conclusion** Surgical treatment of isolated aseptic loosening of the acetabular component requires differentiated tactical solutions for defining the scope of hip revision.

**Keywords:** aseptic loosening, acetabular component, revision arthroplasty, stable stem

### INTRODUCTION

Aseptic loosening of the acetabular component is one of the most common late complications after total hip arthroplasty [1, 2]. Its incidence ranges from 15 to 60 % according to the annual reports of national registries, and reaches the maximum 10 years after the index implantation [3, 4, 5]. Aseptic loosening is mainly caused by remodeling of paraprosthesis bone tissue and osteolysis due to "chronic inflammation" triggered by wear debris (microparticles of polyethylene and metal) in the synovial fluid that are formed by friction of the components [6, 7].

Revision arthroplasty with the replacement of an unstable acetabular component and of a "head-and-liner" friction couple is the principle of its treatment. There is still no consensus regarding the stable and correctly oriented femoral component by an isolated loosening of the cup. Some authors, based on the need to reduce the severity of the revision

intervention and taking into account the elderly age of patients with associated comorbidities, recommend to preserve the stem if it is well-aligned and stable [8, 9]. Other authors defend mandatory replacement of a stable stem arguing that an isolated course of paraprosthesis osteolysis is impossible against the background of "chronic inflammation". Moreover, technical difficulties are encountered in adequate visualization of the acetabulum due to protruding implant neck [10, 11]. Thus, the lack of consensus regarding a stable and correctly oriented femoral component in revision arthroplasty in patients with isolated aseptic loosening of the cup determined the relevance of this study.

The purpose of the study was to analyze the results of surgical treatment of patients with isolated aseptic loosening of the acetabular component after total revision arthroplasty.

### MATERIAL AND METHODS

Our study is an analysis of the results of examination and treatment of 16 patients with isolated aseptic loosening of the acetabular component associated with a stable and correctly oriented femoral component who were treated at the trauma

and orthopedic department of FSBI VO NIITON of the Saratov State Medical University named after V.I. Razumovsky of the Ministry of Health of Russia from January 1, 2014 to December 31, 2016. The average age of patients was  $58.9 \pm 8.43$  years. Men-

to-women ratio was 1: 2. Patients' demographic data are presented in Table 1.

Inclusion criteria for the of patients in the study were: 1) isolated loosening of the acetabular component of the implant; 2) stable and well-aligned femoral component; 3) aseptic genesis of the pathology; 4) unilateral hip involvement; 5) pre-operative indicators of red blood cells, hemoglobin, hematocrit within the normal range (RBC 4.30-5.80 10<sup>12</sup>/l; HGB 131-167 g/l; HCT 0.399-0.510 l/l); 6) concomitant pathology in the stage of compensation.

The diagnosis was made on the basis of clinical (pain, limitation of range of motion in the operated hip joint, change in limb length, positive Stinchfield test) and X-ray findings (N.V. Zagorodniy's criteria in the DeLee-Charnley zones) as well as laboratory tests (WBC <9.0 × 10<sup>9</sup> / L, negative CRP, no leukocyte shift to the left).

Acetabulum bone defects were graded according to the classification W.G. Paprosky (Table 2).

All 16 patients underwent revision arthroplasty from the antero-lateral approach to the hip joint under combined anesthesia. The main reason for extraction of a stable and correctly aligned femoral component

in our study was a non-standard cone of the stem neck and unavailable heads of the required size for it (**Fig. 1**). A special revision tool was used for removal (**Fig. 2**). Next, the unstable acetabular component was replaced, the liner impacted and the revision femoral component with the head to the standard neck size of 12/14 mm was installed. Passive drainage was applied on the first postoperative day.

Distribution of patients according to the acetabular components applied was as follows: 11 patients (68.75 %) had Burch-Schneider (Zimmer) reinforcing rings due to significant destruction of the acetabulum (types 2C and 3A) including seven (43.75 %) with additional plasty with Osteoset allografts (Wright) and ChronOS Vivify Block Beta-TCP (DePuy Synthes). Screwed Bicon cups (Smith & Nephew) were implanted in three patients (18.75 %) with bone defects of type 2A and 2B. Pinnacle Gription acetabular component (De Puy) was used in 2 patients (12.5 %) with type 1 according to the classification W.G. Paprosky.

Femoral components used were SL-Plus (Smith&Nephew) in eight patient (50 %), SLR-Plus (Smith&Nephew) in seven subjects (43.75 %), and Corail Revision was used in one (6.25 %).

Table 1

Gender and age of the patients treated

Age	< 50	51-60	61-70	> 70	Total
Males	1 (6.25 %)	1 (6.25 %)	3 (18.75 %)	0 (0 %)	5 (31.25 %)
Females	1 (6.25 %)	6 (37.5 %)	3 (18.75 %)	1 (6.25 %)	11 (68.75 %)
Total	2 (12.5 %)	7 (43.75 %)	6 (37.5 %)	1 (6.25 %)	16 (100 %)

Table 2

Types of acetabular bone defects

Number of patients	Defect type						Total
	Type 1	Type 2A	Type 2B	Type 2C	Type 3A	Type 3B	
Absolute	2	1	2	4	7	0	16
Relative	12.5 %	6.25 %	12.5 %	25 %	43.75 %	0	100 %



**Fig. 1** Nonstandard cone of the femoral component



**Fig. 2** Extraction of a stable well-aligned femoral component

Administration of medication in the early postoperative period included antibacterial (3<sup>rd</sup> generation cephalosporins), anticoagulant (low molecular weight heparin) and analgesic (selective COX-2 NSAIDs) preparations. Activation of patients by sitting down and assigning respiratory exercises began on the first postoperative day; walking with a dosed load on the operated limb with the help of crutches was indicated from the second postoperative day (within 3 months). Additional supports were ceased in the absence of pain and signs of osteolysis according to control radiographs. The results of the study were evaluated using standard Harris Hip Score and Oxford Hip Score questionnaires on the 10<sup>th</sup> postoperative day, and upon 3, 6, and 12 months after the revision intervention. The average follow-up was  $22 \pm 7$  months.

Statistical data processing was performed using Microsoft Excel AtteStat 12.0.5 add-on package.

Quantitative indicators were presented as Me [Q1; Q3], where Me is the median and [Q1; Q3] interquartile range, Q1 – 25 %, Q3 – 75 %. The comparison of the medians was performed using the non-parametric Mann-Whitney test due to a small sample and rejection of the hypothesis about the normal distribution of variation rows. The statistical hypothesis was considered reliable at  $p < 0.05$ .

The study was conducted after signing of informed consent by patients and upon resolution of the ethics committee in accordance with ethical standards developed in accordance with the Helsinki Declaration of the World Association "Ethical Principles of Medical Research Involving Human subjects", as amended in 2000, and the Rules of Clinical Practice in the Russian Federation, approved by the Order of the Ministry of Health of the Russian Federation No. 266 dated June 19, 2003.

## RESULTS

As mentioned above, the severity of the revision played an important role in achieving treatment outcome in this group of patients. The average duration of the operation was 132.5 [115; 150] minutes. The volume of intraoperative blood loss ranged from 600 to 2500 ml and reached an average of 900 [750; 1450] ml. Analysis of the results of hematological parameters (RBC; HGB; HCT), estimated on the 10<sup>th</sup> postoperative day, showed moderate anemia in 14 patients (87.5 %) and only two patients (12.5 %) had mild anemia (Table 3). The average volume of red blood cell transfusion was 450 [300; 775] ml.

The results of the revision surgery in all 16 patients were studied on the 10<sup>th</sup> postoperative day, and then at follow-ups after 3, 6 and 12 months using the Harris Hip Score questionnaire and the Oxford Hip Score questionnaire.

On the 10<sup>th</sup> postoperative day and 3 months after the revision intervention, the functional outcomes according to the Harris Hip Score scale were unsatisfactory. A significant improvement was noted by 6 months after surgery. The final

results of treatment, assessed after 12 months, were fair (**Fig. 3**).

Result of treatment, point (points before surgery, 10 days, 3 months, 6 months, 12 months)

According to the Oxford Hip Score hip joint assessment scale, the result before the revision intervention was between 0 and 19 points, which indicated the presence of severe pathology in the patients requiring surgical treatment. On the 10<sup>th</sup> postoperative day, this indicator was at a level from 20 to 29 points and showed the need for additional examination with a high probability of surgery. After three, six and 12 months, the score was in the range from 30 to 39 points and indicated the need for additional conservative measures to stabilize the condition (**Fig. 4**).

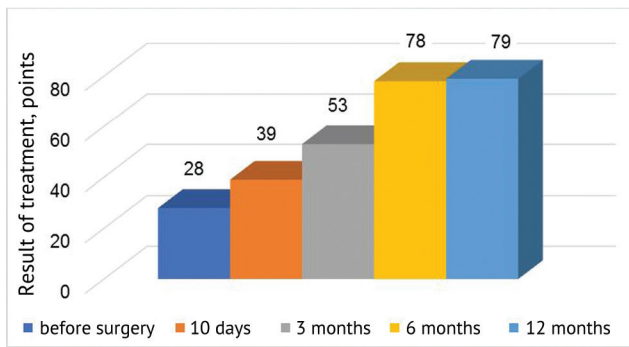
There were no postoperative complications that required a revision intervention in any patient during the entire follow-up period.

Aseptic instability in the replaced femoral components did not develop in the follow-up period of  $22 \pm 7$  months.

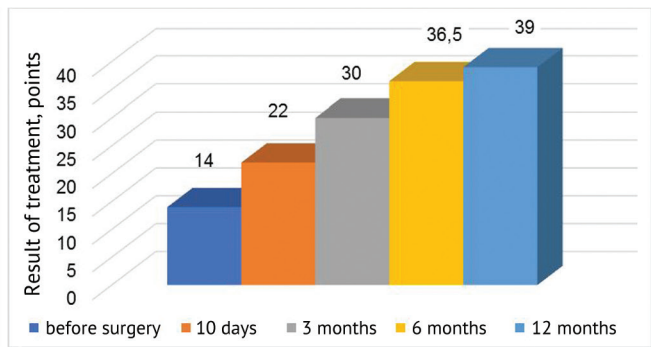
Table 3

### Hematological indices

Test	RBC, $10^{12}/L$	HGB, g/L	HCT, %
Before revision	4,7 [4,4; 4,89]	141,5 [139; 145]	44,3 [0,42; 0,46]
After revision	3,26 [2,9; 3,5]	90 [87,5; 97]	28,6 [26,5; 30,1]



**Fig. 3** Functional result of treatment according to the Harris Hip Score



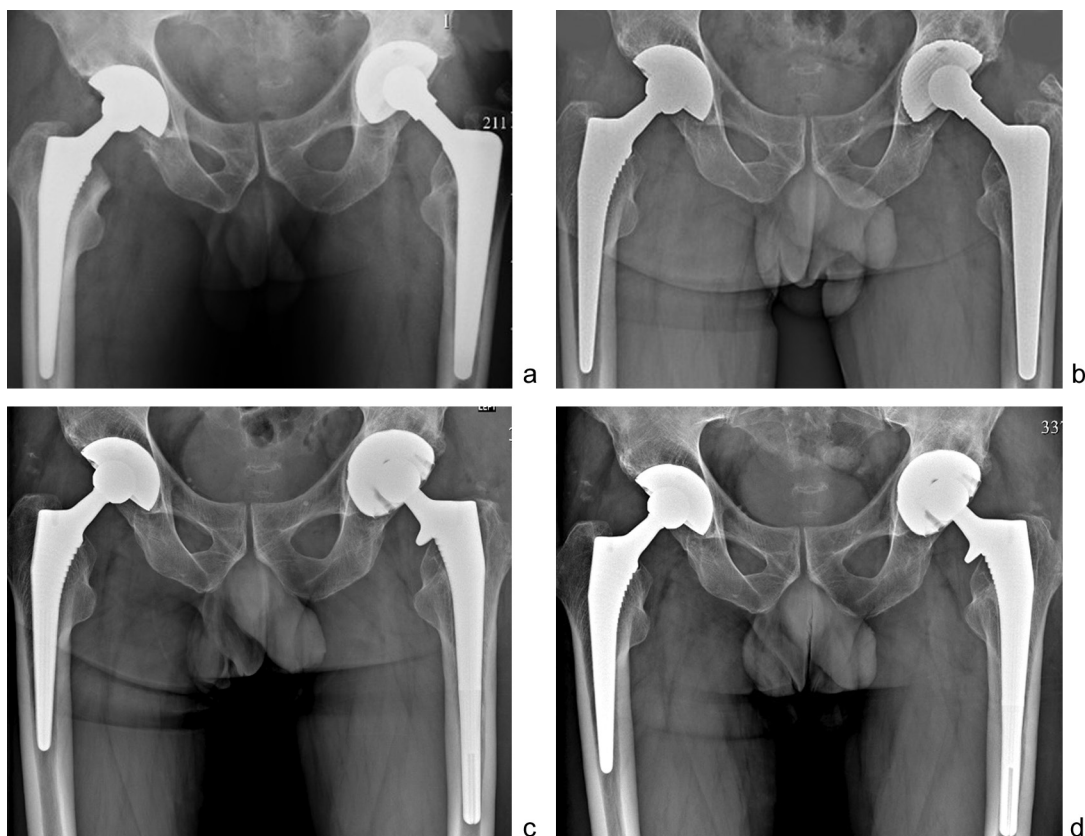
**Fig. 4** Treatment results with Oxford Hip Score

**Case report.** Patient K., 67 years old, retired. Due to bilateral idiopathic coxarthrosis, total arthroplasty of the left hip joint was performed in 2005, and in 2010 of the right hip joint (**Fig. 5, a**). The postoperative period ran smoothly. In December 2013, pain appeared in the left hip joint by changing from a sitting to a standing position and limited range of movements.

There was a 3-mm line of enlightenment wide around the acetabular component in DeLee-Charnley zones 1, 2, 3 in the control radiograph. The femoral component was well-aligned and stable (**Fig. 5, b**). Stinchfield test was positive. Postoperative scar had no signs of inflammation. Harris score was 30 points and the Oxford Hip Score was 16 points. Laboratory

test showed the leukocyte content within the normal range; there was no shift in leukocyte count, and CRP was negative.

Revision of the left hip joint was performed in November 2014. There were no pathological granulations but there was instability of the acetabular component while the femoral component with a 11/13-mm cone was correctly oriented without any micromobility. Total revision was performed (**Fig. 5, c**). The duration of the operation was 130 minutes, intraoperative blood loss was 2500 ml. In the radiograph 12 months after the revision intervention, the position of the components was satisfactory. No signs of osteolysis were detected (**Fig. 5, d**).



**Fig. 5** AP radiographs of the pelvis in patient K: **a** – after index intervention; **b** – before revision; **c** – after revision; **d** – 12 months follow-up after revision



Harris Hip Score was 40 points on the 10<sup>th</sup> postoperative day, with further improvement after 3 months to 56 points, after 6 months up to 80 points, and remained 80 points after 12 months.

Oxford Hip Score was 21 points on the 10<sup>th</sup> postoperative day, 30 points after 3 months, 39 points after 6 months, and 39 points after 12 months.

## DISCUSSION

In this study, we evaluated clinical and radiological results of total replacement of the implant components in 16 patients with isolated aseptic loosening of the acetabular component.

Replacing the stable and well-aligned stem was accompanied by significant duration of the revision intervention and the volume of intraoperative blood loss, which is comparable with the data of world literature [8]. Post-hemorrhagic anemia in patients in the early postoperative period, as a result of this, despite the active transfusion of blood components, contributed to the deterioration of the general condition of patients, which manifested itself in extremely low values of the Harris Hip Score and Oxford Hip Score on the 10<sup>th</sup> postoperative day.

Loss of the bone mass of the hip that accompanied the extraction of a stable femoral component also led to a deterioration in clinical results of the revision intervention [12]. In our study, OHS and HHS at 6 and 12 months were at a satisfactory level. This fact, according to the authors, is associated with the need to use allografts for bone defects of the femur and prolonged limitation of weight-bearing (no more than 20–30 % for 3 months) on the operated lower limb.

We should also consider the economic component of the total revision intervention. After extraction of a stable femoral component, the resulting defects of the femur, as a rule, require allografting and the installation of the stem, which significantly increases the cost of the operation.

However, despite all the obvious shortcomings of the total revision, there are a number of factors that justify the need to replace a stable and well-aligned femoral component.

One of these factors is the limitation of visibility of the acetabular component by the stem if it is preserved during the operation, which makes access to the acetabulum and reconstruction of its bone defects more difficult, increasing the risk of dislocations in the postoperative period [13]. This is confirmed by the results of our study, according to which not a single case of dislocation was recorded for the entire observation period after the total revision. However, it should be noted that the use of anterolateral combined access, according to some authors, can solve this problem by cutting off the tendons of the middle and small gluteus muscles, thereby increasing the mobility of the thigh and improving the visibility of the acetabulum [14].

Another factor justifying the need for total replacement of components is a non-standard cone of the implant stem and unavailable heads for it. Replacement of the head is an obligatory stage of revision intervention on the hip joint in patients with aseptic loosening, since the wear of a friction couple is considered a major etiological factor. Currently, the generally accepted size of the cone is 12/14 mm in diameter. The diameters of cones 10/11 mm, 11/13 mm, and 10/12 mm were used before 2010 [15]. Considering the fact that aseptic instability of the acetabular component is a late complication of total hip arthroplasty reaching the maximum incidence 10 years after the index intervention, orthopedists encounter the problem of non-standard cones and the lack of heads for them in the last three to 4 years.

All the above factors lead to the conclusion about the need for a differentiated approach to the choice of the scope of revision intervention in patients with isolated aseptic loosening of the acetabular component.

## CONCLUSIONS

1. Total revision surgery with the replacement of a stable and well-aligned femoral component is characterized by an increase in the duration of the operation and volume of intraoperative blood loss and a satisfactory functional result of treatment.

2. Replacement of a stable and well-aligned

femoral component is indicated for patients with non-standard sizes of the stem cone.

3. With a standard cone of a stable and well-aligned femoral component, preference should be given to an isolated acetabular revision with the replacement of a head-and-liner friction couple.

**Conflict of interest** The authors of this article declare that there is no conflict of interest, which must be reported.

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