

## The Method of Acetabular Component Installation in Total Hip Arthroplasty in Case of Osteoporosis Caused by Consequences of Traumas

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### Abstract

**Introduction:** A stable long-term fixation of acetabular component at total hip arthroplasty (THA) of patients with osteoporosis and changed anatomy of hip joint is a difficult aim.

**The aim:** To study the results of the use of enhancing osteoporotic acetabular walls with bone autografts and ceramics at THA in patients with consequences of traumas of the hip in early period of follow up.

**Material and Methods:** In the department of Joint Pathology in Sytenko Institute of Spine and Joint Pathology in the period from 2013 to 2015, 21 patients (21 hips) with the consequences of hip traumas underwent THA arthroplasty using enhancing of acetabular osteoporotic walls with spongy bone autografts and ceramics. 15 patients had nonunion of the femoral neck fracture; 1 patient - nonunion on the intertrochanteric level of the proximal femur; 1 patient - nonunion on the subtrochanteric level of the proximal femur, 3 patients had post-traumatic avascular necrosis of the femoral head; 1 - had post-traumatic osteoarthritis with femoral neck nonunion. The average age of patients was 64.1 years old (from 42 to 78 years old), among them, there were 12 men and 9 women.

**Results:** The average duration of follow-up was 15 months (from 4 to 34). Functional results according to the Harris hip score rose on average from 34 to 88 points. In all cases, during the follow up period, radiologic and clinical signs of acetabular component instability were not noted. In spite of this, osteointegration with acetabular component was seen in all three zones according to DeLee and Charnley scheme.

**Conclusion:** The results of study confirm the effectiveness and practical value of this method's application in THA, in case of osteoporosis of acetabulum at consequences of traumas of the hip in early period of follow up.

**Keywords:** Hip; Acetabulum; Osteoporosis; Autografts; Ceramics; Total Hip Arthroplasty

### Introduction

Despite the presence and the use of new design implants, new materials, new methods of components' fixation, the percentage of complications after THA in patients with consequences of traumas of the hip amount from 9 to 20% [1-8], that exceeds the index of complications in primary arthroplasty apropos coxarthrosis in 3 - 4 times. These complications include: periprosthetic fractures, femoral head dislocation, early aseptic instability, infection [9].

A high percentage of these complications are associated with anatomical changes in the hip joint that have arisen because of trauma [9,10], as well as the presence of senile osteoporosis and resulting from a prolonged dysfunction of lower limb and muscular atrophy, which further affects the bone mineral density.

Osteoporosis aggravates both qualitative and quantitative properties of bone tissue, leading to attenuation of bone metabolism in the acceleration of osteoclastogenesis and bone resorption [11-13], which is an unfavorable condition for the arthroplasty and for a stable fixation of implant components [9,14-16].

In THA of patients with changed anatomy and the presence of acetabular osteoporosis, a very important and difficult task is a long-term stable fixation of the acetabular component.

### Objective

To study the results of the use of enhancing osteoporotic acetabular walls with bone autografts and ceramics at THA in patients with consequences of traumas of the hip in early period of follow up.

### Material and Methods

In the department of Joint Pathology in Sytenko Institute of Spine and Joint Pathology in the period from 2013 to 2015, 21 patients (21 hips) with the consequences of hip traumas underwent THA arthroplasty using enhancing of acetabular osteoporotic walls with spongiuous bone autografts and ceramics. 15 patients had nonunion of the femoral neck fracture; 1 patient - nonunion on the intertrochanteric level of the proximal femur; 1 patient - nonunion on the subtrochanteric level of the proximal femur, 3 patients had post-traumatic avascular necrosis of the femoral head; 1 - had post-traumatic osteoarthritis with femoral neck nonunion. The average age of patients was 64.1 years old (from 42 to 78 years old), among them, there were 12 men and 9 women. In 8 patients hardware in the proximal femur was previously installed.

In the 13 cases was performed cementless arthroplasty, in 7 cases- cemented and in 1 case - reverse hybrid. Acetabular component with «press-fit» fixation was installed: «Zimmer Continuum» in 2 patients, «Zimmer Trabecular Metal» in 1 patient, «Zimmer Trilogy» in 2 patients, «Mathys RM» in 4 patients, «Mathys SeleXys» in 4 patients; and cemental fixation: «Mathys CCA» in 1 patient, «Link Lubinus» in 4 patients, «Beznoska» in 1 patient, «Smith & Nephew All Poly» in 1 patient, «Irene» in 1 patient. In one case Müller antiprotusio ring was installed.

When expressed osteoporosis, in order to have a tight implantation of acetabular component in 3 cases of “press-fit” fixation a cup with diameter of 4 mm and over larger than the diameter of the rimmer was used.

In all cases, a direct lateral approach to the hip joint was used. Osteoporotic acetabular walls were enhanced by using spongiuous grafts from femoral head and from greater trochanter, grafts had a cylindrical form, were 6 - 8 mm sized, and with the help of impactor acetabular walls were grafted by all its perimeter. When bone grafts were insufficient biphasic ceramics with porous granules by 4 - 6 mm diameter with 40 - 70% porosity were used (in four cases), the ceramics used were composed by hydroxyapatite: 60 % of weight was porous hydroxyapatite, 40% of weight was tricalcium phosphate. The composition and structure of ceramic granules were synthesized by an original techniques in Kharkov National University named Karazin at the Department of Physics, and authorized for use in clinical practice [17]. The need to perform this manipulation was intraoperatively determinated, as by grafting osteoporotic acetabular walls, free punching of the acetabular wall occurred. After that acetabular component was installed.

Densitometric analysis conducted in our study also confirmed the phenomena of osteopaenia and osteoporosis, which were conducted on bone densitometer «Hologic Explorer QDR» (USA), the degree of osteoporosis was determined by criteria T, Z and BMD.

On the second day after surgery patients were activated and trained walking on crutches, physical rehabilitation was carried out, aimed at gluteal muscle groups and quadriceps strengthening. The dosage load on the operated limb was recommended up to 3 months after surgery. Osteotrophic therapy was prescribed to all postoperative patients.

Results of arthroplasty were evaluated using the Harris hip score [18], which considers the functionality and pain condition in patients after arthroplasty.

Radiologically the evaluation of bone structure around the implant cup was performed following DeLee and Charnley scheme [19].

This scheme includes a division of the acetabular cup into three areas.

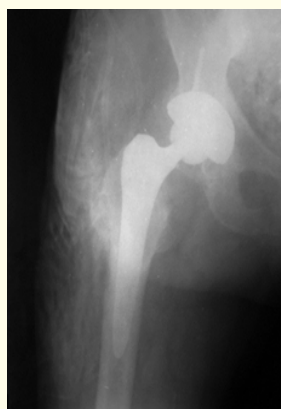
### Results

Positive results of treatment with a mean follow of 15 months (from 4 to 34) after the operation were obtained in 100% of cases. Functional state of the hip by Harris hip score increased on average from 34 to 88 points. In all cases, during the follow up period, radiologic and clinical signs of acetabular component instability were not noted. In spite of this, osteointegration with acetabular component was seen in all three zones according to DeLee and Charnley scheme. In neither case, any osteolysis was observed.

Here the clinical examples are provided:

1. Patient S., 75 y.o. Diagnosis: Pseudoarthrosis of the right femoral neck after failed fracture fixation. On the right hip X-ray a manifested local acetabular and proximal femur osteoporosis were noticed, which was confirmed by densitometry data. In proximal femur area 2 screws were located (Figure 1a). Hip functional condition was 26 points by Harris hip score.

The hardware was removed, right hip cementless arthroplasty was performed with endoprosthesis «Mathys». Acetabular component «SeleXys» was established by grafting enhancing osteoporotic acetabular walls with spongiuous autografts taken from femoral head (Figure 1b). One year after the intervention X-ray control was made. The acetabular component position stayed without changing and didn't have any instability features. There was an amelioration in the bone structure around the acetabular component and the presence of a close contact in all its areas by DeLee and Charnley scheme (Figure 1c, 1d). The Harris hip score increased up to 84 points.



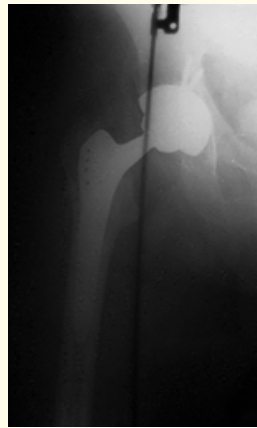
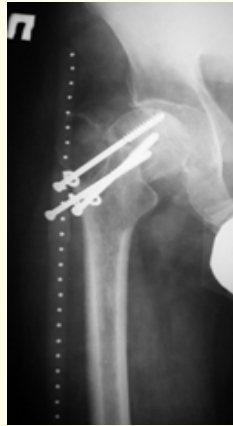


**Figure 1:** X-ray prints of patient S, 75 y.o.: pseudoarthrosis of right femoral neck (a); after THA (b); one year after THA (c, d).

2. Patient Ya., 42 y.o. Diagnosis: Pseudoarthrosis of right femur neck after failed fracture fixation. On the right hip X-ray an expressed local acetabular and proximal femur osteoporosis was noted, that was confirmed by densitometry data (Figure 2a). Functional hip status by Harris hip score was 28 points.

A cementless THA of right hip was performed with endoprosthesis «Zimmer». Acetabular component «Continuum» was established by enhancing acetabular osteoporotic walls with spongius autografts taken from femoral head (Figure 2b). Control X-ray 2 years after intervention. The position of acetabular component stayed without variations, without instability signs, an amelioration of bone tissue structure around acetabular component and the presence of a close contact in all its areas by DeLee and Charnley scheme (Figure 2 c, 2d). Functional hip condition by Harris hip score rose to 87 points.

Clinical examples given below showed the practical value of using method of enhancing acetabular walls in osteoporosis to achieve primary stable cup fixation in THA.





**Figure 2:** X-ray prints of patient Ya, 24 y.o: pseudoarthrosis of the right femoral neck, failed fixation after right femoral neck fracture (a), after THA (b) and 2 years after THA (c,d).

## Conclusion

The results of our research have shown the effectiveness and practical value of this method's application in THA, in case of osteoporosis of acetabulum at consequences of traumas of the hip in early period of follow up.

Enhancing of osteoporotic acetabular bone with autografts and ceramics provides stable primary cup fixation in acetabulum, allows reaching a durable secondary fixation, protection of spongy tissue against load decay; it enables the possibility of implanting acetabular component with «press-fit» fixation.

## Conflict of Interest

The authors declare that there is no conflict of interest connected with this study.

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