

POSTERIOR-BUTTRESS AUGMENTATION IN PAPROSKY TYPE IIIA ACETABULAR DEFECTS: 4-YEAR FOLLOW-UP

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Abstract — Revision total hip arthroplasty in the setting of Paprosky type IIIA acetabular defects poses a major surgical challenge because of superolateral bone loss, migration of the hip centre of rotation, and altered hip biomechanics. The aim of this study was to analyse the biomechanical rationale, clinical outcomes, and early functional outcomes of reconstructing Paprosky type IIIA defects using a tantalum buttress augment.

A retrospective analysis was performed of six patients (five women and one man) with a mean age of 69 years and a minimum follow-up of four years. The inclusion criterion was an intraoperatively confirmed Paprosky type IIIA acetabular defect. In four patients, revision was performed according to a two-stage protocol for periprosthetic joint infection, whereas in two it was undertaken for aseptic loosening. Reconstruction was achieved using a tantalum buttress augment in combination with an uncemented tantalum acetabular cup, resulting in a stable monoblock construct.

Clinical assessment using the Harris Hip Score (HHS) demonstrated a 26%-30% improvement at 6 months postoperatively compared with preoperative values, indicating an early functional benefit. At 4-year follow-up, no signs of mechanical instability or radiographic loosening were identified.

These findings confirm that the tantalum buttress augment provides stable primary fixation, reliable osseointegration, and clinically significant functional improvement in the management of Paprosky type IIIA acetabular defects.

Keywords: revision total hip arthroplasty; Paprosky IIIA; acetabular defect; tantalum augment; buttress augment; monoblock construct; Harris Hip Score.

1. INTRODUCTION

Revision total hip arthroplasty (rTHA) accounts for an increasing proportion of orthopaedic practice worldwide. The growing number of primary arthroplasties, the expansion of indications to younger and more active patients, and increasing life expectancy have led to a progressive rise in the need for revision procedures. One of the most

serious problems in revision surgery is acetabular bone loss, which makes it difficult to achieve stable primary fixation and long-term osseointegration.¹

The William G. Paprosky classification remains the gold standard for the assessment of acetabular defects in revision surgery. Type IIIA defects are characterised by substantial superoposterior bone loss, proximal migration of the centre of rotation of more than 3 cm, a compromised superior wall, and often reduced bony coverage of the implant.¹¹ Although column stability is usually relatively preserved, the biomechanical disturbance is substantial. The elevated centre of rotation leads to a reduced abductor lever arm, increased loading of the polyethylene liner, and a higher risk of dislocation and aseptic loosening. **(Figure 1, Figure 2).**

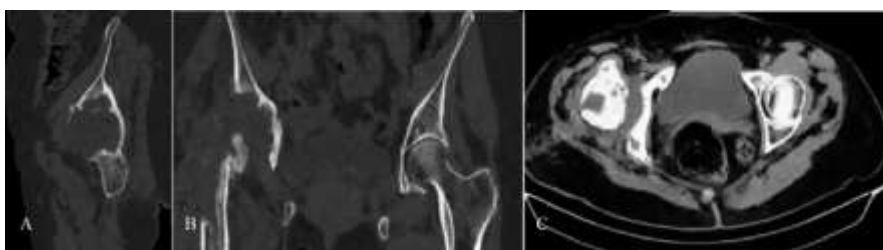


Figure 1: Main characteristics of Paprosky type IIIA defects: intact posterior column (A); substantial superoposterior bone loss with proximal migration of the centre of rotation >3 cm (B); absence of medial migration and preservation of Kohler's line(C).

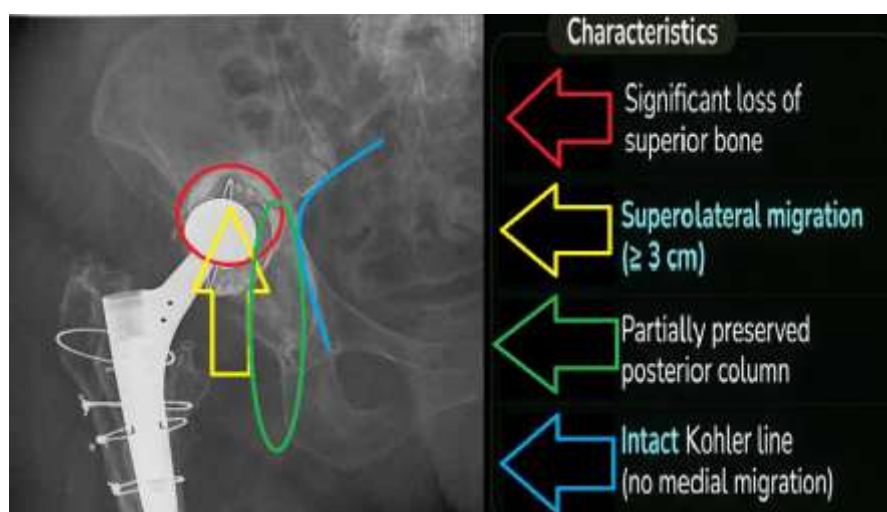


Figure 2: Preoperative radiograph showing the radiographic criteria for a Paprosky type IIIA acetabular defect.

The main goals of reconstruction of Paprosky type IIIA defects include:

- restoration of the anatomic hip centre of rotation;
- achievement of stable primary fixation;
- creation of conditions for secondary biological osseointegration;

- minimisation of the risk of dislocation and mechanical instability.

Historically, various surgical options for managing extensive acetabular defects are considered, including structural bone grafts, antiprotrusion cages, jumbo cups, custom triflange implants, and impaction bone grafting^{13,17}. However, these methods are associated with several limitations, including graft resorption, prolonged time to biological integration, mechanical instability, and the need for complex custom implant manufacture. High revision rates have been reported in massive defects, particularly in Paprosky type IIIA lesions.

In this context, porous metal implants, particularly tantalum systems, have assumed major importance. Tantalum is characterised by the following features: **(Figure 3)**

- high three-dimensional porosity (70-80%);
- a low modulus of elasticity close to that of cancellous bone;
- a high coefficient of friction at the implant-bone interface;
- proven osteoinductivity.

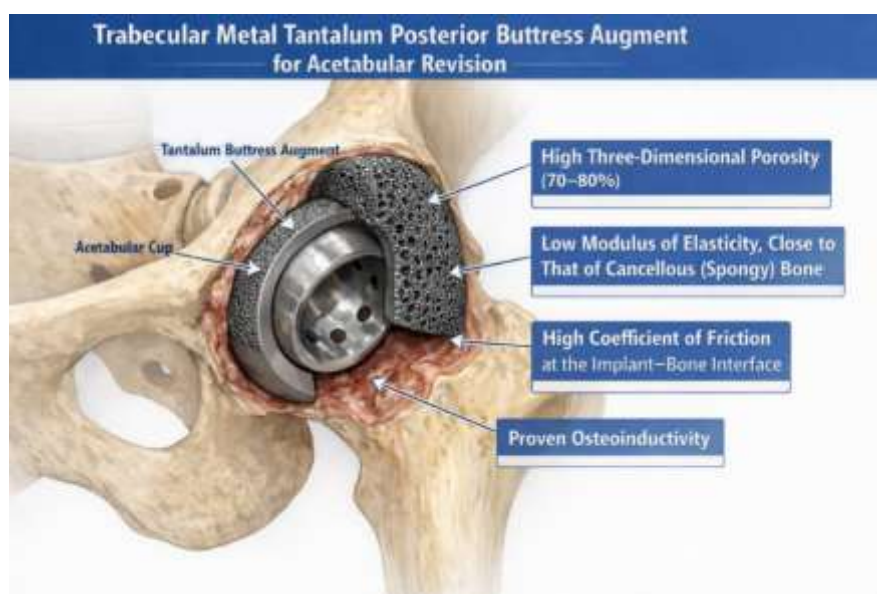


Figure 3: Primary advantages of tantalum augments.

The tantalum buttress augment is particularly well suited to superolateral segmental Paprosky type IIIA defects. It restores iliac support, reduces migration of the centre of rotation, and allows stable implantation of a revision cup, whether uncemented or cemented, including dual mobility systems in patients at high risk of dislocation.

Modular tantalum augments allow anatomical filling of segmental defects and restoration of superolateral support. The modularity of the system permits the creation of a monoblock construct by placing a thin layer of high-viscosity bone cement between

the individual modules. This monoblock design principle minimises micromotion between the components and provides a stable mechanical basis for secondary osseointegration.¹

The potential for biological fixation and osseointegration makes tantalum implants suitable for the reconstruction of severe acetabular bone loss, including Paprosky type III A defects and cases associated with pelvic discontinuity. In such complex situations, they represent a valuable alternative to traditional antiprotrusio cages. Rather than relying on a structural allograft–cage construct, the use of a cup-cage reconstruction incorporating trabecular metal (TM) components has been proposed, providing enhanced biological integration and long-term mechanical stability.¹⁵

2. MATERIALS AND METHODS

The present study is a retrospective analysis of a consecutive series of patients who underwent revision total hip arthroplasty with reconstruction of Paprosky type IIIA acetabular defects using a tantalum buttress augment.

A total of six patients (six hip joints) with a mean age of 69 years were included in the study. Five were women and one was a man. The inclusion criterion was an intraoperatively identified acetabular defect classified as Paprosky type IIIA. Classification was performed after explantation of the previous components and direct intraoperative assessment of the bone defect.

In four patients, the indication for revision surgery was periprosthetic joint infection treated according to a two-stage protocol, with initial explantation and placement of an antibiotic spacer followed by reimplantation after control of the infection. In the remaining two patients, revision was undertaken for aseptic loosening of the acetabular component.

After preparation of the acetabular bed, reconstruction was performed by placing a tantalum augment in a buttress configuration in order to restore superolateral support and the centre of rotation. An uncemented tantalum acetabular cup was implanted using a press-fit technique. A stable monoblock construct was created between the augment and the cup, ensuring mechanical integration of the two components and minimising micromotion at the interface. Primary stability was achieved by press-fit fixation, with additional screw fixation when necessary.

3. RESULTS

Clinical evaluation was performed using the Harris Hip Score (HHS) preoperatively, at 6 months postoperatively, and at final follow-up. At 6 months postoperatively, a mean 28% improvement in HHS was observed compared with preoperative values. Follow-up extended to 4 years and included assessment of pain, functional capacity, and hip stability.

No clinical or laboratory evidence of reinfection was observed in the patients who underwent revision for periprosthetic joint infection (PJI).

Radiographic evaluation was performed using standard anteroposterior pelvic radiographs and lateral views of the hip. The position of the acetabular cup and augment, the presence of radiolucent lines, component migration, and any breakage of fixation screws were assessed. Signs of loosening were defined as migration of more than 3 mm, progressive radiolucent lines, change in implant position, or significant pain. (**Figure 4**)



Figure 4: Follow-up radiographs: postoperative (A) and 6 months postoperatively (B).

The observed 28% improvement in HHS at 6 months demonstrates a clinically significant early functional benefit of the reconstructive technique in the absence of major intraoperative or postoperative complications.

4. DISCUSSION

Reconstruction of Paprosky type IIIA acetabular defects remains one of the greatest challenges in revision hip arthroplasty. The main problem in these defects is superolateral bone loss, which leads to proximal migration of the centre of rotation and altered hip biomechanics. Restoration of the anatomic centre of rotation and achievement of stable primary fixation are critical factors for long-term implant survivorship.¹

In a series of seven patient with Paprosky 3-4 defect, Kinov et al. report excellent short-term result with stable primary stability and full osteointegration on the 3rd post op. mount. Complications such as dislocation and ectopic ossification (Broeker type 3) are also reported.¹⁴

In the published series by Spranz et al., survivorship of the acetabular component in Paprosky type IIIA defects reconstructed with a modular tantalum augment and a cemented cup reached 96.2% at a mean follow-up of 4.5 years.¹ These results are comparable to those reported by Alqwbani et al., who found 100% acetabular component survivorship with tantalum augments at a mean follow-up of 6.25 years.⁶ Flecher et al.

reported survivorship of 92.3% in Paprosky type III defects,⁷ whereas Eachempati et al. reported 100% survivorship in Paprosky type IIIA/IIIB defects.⁸ Comparison of these results suggests that tantalum augments provide a stable mechanical foundation in severe acetabular defects.

Radiographic stability in the series by Fonseca Neto et al. demonstrated 100% fixation in Paprosky type IIIA/IIIB defects at a mean follow-up of 39.4 months.² This supports the concept of high primary stability owing to the high coefficient of friction and three-dimensional porosity of tantalum. The biomechanical characteristics of porous tantalum, including a modulus of elasticity close to that of cancellous bone and high osteoconductivity, have been described in detail by Levine et al.¹⁰ These properties allow deep bone ingrowth and stable secondary fixation.

In addition to standard modular augments, custom trabecular titanium implants in Paprosky type III defects have shown significant functional improvement.³ However, custom implants are associated with higher cost and longer manufacturing times, making modular tantalum augments a more practical option in everyday clinical practice.³

Of particular interest is systemic exposure to tantalum. In the series by Spranz et al., elevated mean serum tantalum concentrations (0.16 µg/L) were found compared with controls.¹ Brüggemann et al. also reported elevated blood levels following implantation of tantalum components.⁹ Although tantalum is considered a biocompatible metal,¹⁰ the long-term clinical significance of elevated serum concentrations remains unclear. At present, there is no evidence of systemic toxicity, but the need for long-term follow-up is clear.⁹

Comparison of cemented and uncemented revision techniques is also relevant. Whereas the initial recommendations for modular tantalum augments included an impaction technique with a press-fit cup,¹ clinical results have shown that combination with a cemented cup also provides a stable monoblock construct.¹ This is particularly important in patients with poor bone quality or a high risk of dislocation, in whom dual mobility cups reduce the risk of instability.¹

With regard to complications, the rate of aseptic loosening in the analysed series remains low.^{1,6,8} The only cases requiring further revision reported in the published data were related to infection,¹ rather than mechanical failure of the augment. This supports the view that the mechanical stability of tantalum augments is reliable when proper surgical technique is used.

The limitations of the available studies include relatively small patient series, retrospective design, and mid-term follow-up.^{1,3} Long-term data beyond 10 years confirming the durability of reconstruction in Paprosky type IIIA defects are lacking. In addition, direct comparative studies between tantalum augments, custom triflange implants, and massive structural grafts remain limited.

Tantalum augments have become an important reconstructive option in revision hip arthroplasty involving severe acetabular bone loss. Owing to their highly porous structure, high coefficient of friction, and excellent osteoconductive properties, they provide reliable primary stability and promote biological fixation. Their modular design allows anatomical restoration of Paprosky type III defects, facilitates reconstruction of the hip centre of rotation, and may reduce the need for structural allografts and complex cage constructs.¹⁶

5. LIMITATIONS OF OUR STUDY

The principal limitation of this study is the small sample size, comprising only six patients, which reflects the relative rarity and complexity of Paprosky type IIIA acetabular defects treated with this specific reconstructive technique. Consequently, the statistical significance and external validity of the findings are limited. Furthermore, the retrospective nature of the study and the lack of a comparative cohort do not allow definitive conclusions regarding the superiority of this method over other established reconstruction strategies. Despite these limitations, the homogeneous patient population, consistent surgical technique, and four-year follow-up provide meaningful clinical and radiographic data that may contribute to the growing body of evidence supporting the use of tantalum augments in complex acetabular revision surgery. Further investigation would be carried out.

6. CONCLUSION

Available data from published series^{1,3,6,10} demonstrate that tantalum buttress augments provide stable mechanical fixation, reliable osseointegration, and high mid-term survivorship in Paprosky type IIIA defects. Elevated serum tantalum levels warrant further investigation, but at present they do not compromise clinical outcome. These findings support the role of modular tantalum augments as an effective and biomechanically sound reconstructive strategy in complex acetabular revisions and are consistent with our experience and clinical data, as well as with data from meta-analyses of functional outcomes after revision hip arthroplasty.¹²

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