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Research Article

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Posted Date: November 26th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11297143/v1

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Additional Declarations: No competing interests reported.

Case Series Study :Preliminary Experience of Autologous Iliac Bone Reconstruction for Acetabular Floor Defects in revision hip arthroplasty

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Abstract

Background: Paprosky II-III acetabular floor defects present significant challenges in revision hip arthroplasty, lacking established effective treatments.

Methods: In this prospective case series, 6 patients underwent acetabular reconstruction using autologous iliac bone grafts. Through a 6-cm incision along the iliac crest, a 5×3 cm graft was harvested, split transversely, sutured with Vicry-l, and impacted into the defect. Allogeneic bone composite was added, followed by sequential reaming and press-fit cup implantation . Outcomes included intraoperative blood loss, complications, VAS pain scores , HHS, SF-36, and graft

healing.

Results: All donor sites healed without complications. Significant improvements were observed:VAS decreased from 6.8±0.8 preoperatively to 0.2±0.4 at 3 months .HHS increased from 43.5±3.0 to 87.0±3.3 at 3 months.Bone graft healing rate was 100%.Mean blood loss was 817±37 mL.

Conclusion: Autologous iliac bone reconstruction is a feasible and effective technique for Paprosky II-III acetabular floor defects, demonstrating excellent short-term outcomes and graft integration.

Keywords: autologous iliac bone; acetabular defect; revision hip arthroplasty; bone reconstruction; Paprosky classification

1 Introduction

Revision hip arthroplasty is an important means for treating failed hip prostheses. Paprosky II-III type acetabular floor bone defects, as a special type of acetabular bone defects, remain a clinical challenge. Globally, with the increasing number of primary total hip arthroplasty (THA) procedures, the demand for revision surgeries is growing at a rate of about 10% per year[1]. In China, the annual number of THA surgeries has exceeded 300,000 in recent years, with revision surgeries accounting for about 5%-10% of the total, and this proportion is increasing year by year[2]. For Paprosky II-III type acetabular floor bone defects, common treatment methods currently include structural bone grafting, metal augments, and custom implants. However, these methods still have limitations in terms of long-term stability, biocompatibility, and surgical complexity. For example, metal augments may cause stress shielding, while custom implants have long production cycles and high costs[3].

This study introduces a novel technique of autologous iliac bone reconstruction autologous iliac bone reconstruction for acetabular floor bone defects, aiming to explore its short-term and long-term efficacy through a prospective single-center case series. Compared to existing techniques, this method has the advantages of reliable material sourcing, excellent biocompatibility, and superior mechanical properties. A total of 6 patients were included in the study, with observation indicators including surgical time, blood loss, complication rates, and postoperative quality of life. The significance of this study lies in providing a new clinical option for the treatment of Paprosky II-III type acetabular floor bone defects and offering preliminary data support for its application and promotion. It is hoped that this exploration will provide practical guidance for the optimization of revision hip arthroplasty.

2 Methods

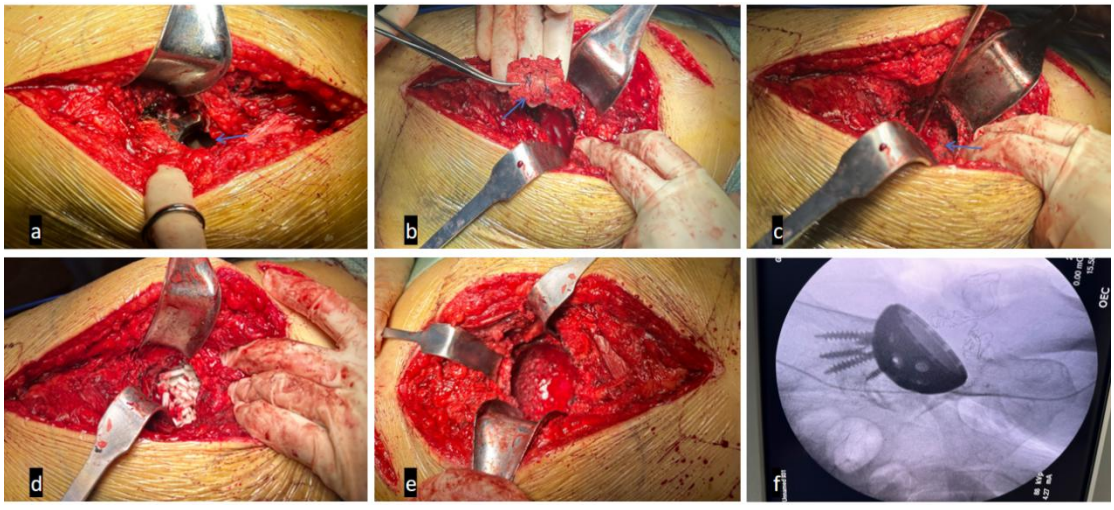
This study is a single-center case series designed to assess the safety and efficacy of autologous iliac bone grafting for acetabular floor bone defects in hip revision surgery. The study period was from November 1, 2024, to August 31, 2025, with a plan to include 6 eligible patients. Clear inclusion and exclusion criteria were established for case selection: Inclusion criteria included confirmed Paprosky II-III type acetabular floor bone defects by imaging (such as X-ray, CT, or MRI)[4], age between 18 and 75 years, ASA grade ≤ III, a clear history of primary hip replacement requiring revision surgery, and signed informed consent. Exclusion criteria covered severe osteoporosis (T-score <-2.5), active infectious diseases, hematologic disorders, lesions in the iliac region, and poor compliance. Data collection was conducted using a uniformly designed data collection form, recording baseline data (such as demographic characteristics, acetabular defect grading, revision reasons, time since the last revision), short-term outcome indicators

(intraoperative blood loss, postoperative complications, donor site complications, preoperative and postoperative day 3 pain scores, preoperative and postoperative 1-day hemoglobin levels), and long-term follow-up indicators (postoperative 1-month and 3-month pain scores, Harris Hip Score [HHS], SF-36 quality of life scores, bone graft healing status). The intervention was autologous iliac bone grafting for acetabular floor bone defect repair, and the surgery was performed by the same senior orthopedic surgeon to ensure consistency of operation. All imaging assessments were independently completed by two senior physicians, with discrepancies resolved by a third physician. Statistical analysis was conducted using SPSS 26.0 software, with continuous variables expressed as mean ± standard deviation and categorical variables described by frequency and percentage. This study received ethical approval from the Institutional Review Board of the First Affiliated Hospital of Guangxi Medical University (Approval No.: 2024-E0964) from the hospital's ethics committee (Approval number: 2024-E0964), and all patients signed informed consent forms to ensure the study complied with the principles of the Helsinki Declaration[5].

The specific surgical procedure for autologous iliac bone reconstruction of the acetabular floor is as follows: 1. Harvesting autologous iliac bone: A straight incision about 6 cm long was made along the anterior superior iliac spine, the skin and subcutaneous tissue were cut open to expose the anterior superior iliac spine, and the surrounding tissues were separated to harvest a piece of iliac bone measuring 5 cm in length and 3 cm in width. After removal, the iliac bone was split along the short side into two halves, with the long sides of the split iliac bone fixed together using 1-0 Vicryl suture. The split iliac bone was wrapped with wet hemostatic gauze and kept on standby. 2. Acetabular preparation: The acetabulum was exposed using an acetabular retractor. The hypertrophic labrum within the acetabulum was removed, and the osteophytes on the outer

upper edge of the acetabulum were bitten off to reveal the true acetabular margin. The autologous iliac bone was inserted into the acetabular floor bone defect, followed by the addition of allogeneic bone + bone repair material. After flattening with a spherical acetabular reamer, more allogeneic bone was added and flattened repeatedly until the acetabulum was stable. The acetabulum was then reamed with a spherical acetabular reamer of gradually increasing diameter, maintaining an abduction angle of about 45 degrees and an anteversion angle of about 10 degrees until it fitted well with the acetabulum. A trial acetabular component was inserted to ensure that the outer upper edge of the acetabular component had bony coverage from the acetabulum. The acetabular component was selected based on the trial size, ensuring an abduction angle of about 45 degrees and an anteversion angle of about 10 degrees when inserted into the acetabulum with a good press-fit. Three screws were inserted into the posterior upper quadrant of the acetabulum, with the tips directed towards the acetabular roof and the front of the sacroiliac joint, ensuring that the screw tails did not protrude beyond the acetabular component's articular surface. A matching polyethylene liner was then inserted into the acetabulum (Fig 1).

Figure 1: Intraoperative Autologous Iliac Bone Reconstruction of the Acetabular Floor



Note: **a** shows the acetabular floor defect after removal of the acetabular component, with the arrow indicating the defective acetabular floor; **b** shows the split iliac bone plate sutured together, with the arrow pointing to the iliac bone plate; **c** shows the iliac bone plate inserted into the acetabular floor, with the arrow pointing to the iliac bone plate; **d** shows the acetabular floor filled with allogeneic bone; **e** shows the acetabular floor after grinding the allogeneic bone; **f** shows the DR image after the acetabular component was installed.

3 Results

3.1 Baseline Data

A total of 6 patients (5 males and 1 female) were included in this study, with a mean age of 63.7 ± 10.6 years and a mean BMI of 24.8 ± 2.7 kg/m². All patients had Paprosky II-III type acetabular bone defects (IIB: 1 case, IIIB: 4 cases, IIC: 1 case). The reasons for revision included infection (2 cases, 33.3%) and prosthesis loosening (4 cases, 66.7%), with an average time since the last replacement of 4.1 ± 4.3 years. The distribution of bone defect grades was as follows: IIIB grade (66.7%), IIIA grade (16.7%), IIB grade (16.7%), and IIC grade (16.7%) (Table 1).

Table 1: Baseline Data of 6 Patients

Case Number	Age (years)	Gender	BMI	Bone Defect Grade	Revision Reason	TimeSince Last Replacement (years)
1	62	Male	25.35	IIIB	Infection	1.5
2	58	Female	24.00	IIIB	Loosening	1.0

3	48	Male	23.88	IIC	Loosening	1.5
4	73	Male	29.41	IIB	Loosening	0.5
5	80	Male	20.76	IIIA	Loosening	8.0
6	61	Male	25.48	IIIB	Infection	12.0
Mean ± SD	63.7 ± 10.6	-	24.8 ± 2.7	-	-	4.1 ± 4.3

Table Note: Gender distribution: 5 males (83.3%) and 1 female (16.7%); Bone defect grades: IIIB grade in 4 cases (66.7%), IIIA grade in 1 case (16.7%), IIB grade in 1 case (16.7%), and IIC grade in 1 case (16.7%); Revision reasons: Infection in 2 cases (33.3%) and loosening in 4 cases (66.7%)

3.2 Short-term Outcome Indicators

Intraoperative Conditions: The average blood loss was 817 ± 36.7 mL. Postoperative Complications: No cases of postoperative infection, nerve injury, or donor site complications occurred (incidence rate 0%). Pain and Hemoglobin Changes: Preoperative pain score: 6.8 ± 0.8; reduced to 1.7 ± 0.5 on postoperative day 3 (a 75% decrease). Preoperative hemoglobin: 133.0 ± 13.6 g/L; reduced to 97.7 ± 11.2 g/L on postoperative day 1 (a 26.5% decrease) (Table 2).

Table 2: Short-term Outcome Indicators

Case	Blood Loss	Postoperative	Nerve Injury	Donor Site	Preoperative	Postoperative Day 3	Preoperative	Postoperative Day 1

number	(mL)	Infection		Complications	Pain Score	Pain Score	Hemoglobin (g/L)	Hemoglobin (g/L)
1	800	No	No	None	7	2	146	116
2	800	No	No	None	6	2	122	83
3	800	No	No	None	7	1	122	87
4	1500	No	No	None	7	2	122	101
5	500	No	No	None	6	2	146	93
6	500	No	No	None	8	1	140	106
Mean ± SD	817 ± 36.7	0%	0%	0%	6.8 ± 0.8	1.7 ± 0.5	133.0 ± 13.6	97.7 ± 11.2

Table Note: The incidence rates of postoperative infection, nerve injury, and donor site complications were all 0%.

3.3 Medium- and Long-term Outcome Indicators

Pain Score Improvement: Postoperative month 1: 0.5 ± 0.5 (a 92.6% decrease compared to preoperative). Postoperative month 3: 0.2 ± 0.4 (a 97.1% decrease compared to preoperative). Hip Function (HHS Score): Preoperative: 43.5 ± 3.0; increased to 87.0 ± 3.3 at postoperative month 3 (a 100% improvement). Bone Graft Healing and Quality of Life: Postoperative month 3 bone graft healing rate: 50% (3 out of 6 reviewed cases showed good healing, while the other 3 cases were not reviewed). SF-36 quality of life score: 30.5 ± 2.1 (moderate level) (Table 3).

Table 3: Medium- and Long-term Outcome Indicators (Postoperative Month 3)

Case Number	Postoperative Month 1 Pain Score	Postoperative Month 3 Pain Score	Bone Graft Healing Status	SF-36 Score	Preoperative HHS Score	Postoperative Month 1 HHS Score	Postoperative Month 3 HHS Score
1	0	0	Not reviewed	30	40	72	86
2	1	0	Good	32	46	76	89
3	1	1	Not reviewed	31	48	75	92
4	0	0	Good	27	43	72	86
5	1	0	Good	33	41	72	85
6	0	0	Not reviewed	30	43	73	83
Mean ± SD	0.5 ± 0.5	0.2 ± 0.4	-	30.5 ± 2.1	43.5 ± 3.0	73.0 ± 1.7	87.0 ± 3.3

*Table Note: 1. *Pain scores were assessed using the Visual Analog Scale (VAS) (0-10 points). 2. Bone graft healing rate: All 3 reviewed cases showed good healing (100%), while the other 3 cases were not reviewed. 3. HHS: Harris Hip Score (maximum 100 points). 4. SF-36: Quality of life score (maximum 100 points)

4 Discussion

4.1 Common Approaches and Clinical Challenges in Acetabular Floor Defect Revision

Revision of acetabular bone defects is a common challenge in revision hip arthroplasty. The most common difficulties are concentrated in Paprosky IIIA-IIIB types (accounting for 35%-45% of revision cases), which require both mechanical and biological reconstruction[1, 6]. As a complex type of bone defect, the current mainstream revision methods for acetabular floor defects have significant limitations[7]. For example, conventional structural bone grafting carries a risk of bone resorption (with an incidence rate of 15%-20%) and poor long-term stability[1]. Additionally, due to the inadequate filling of the acetabular floor, the grafted bone blocks are prone to displacement and formation of heterotopic ossification. For a period of time, many scholars have used metal augment transplantation to reconstruct the acetabular floor for acetabular floor defects[8], achieving certain effects. However, stress shielding effects still lead to further bone loss in the grafted area, with literature reporting a revision rate exceeding 18% within 5 years[9]. Moreover, the use of traditional cemented prostheses for acetabular floor defect revision has been decreasing[10]. Although reports indicate no significant differences in outcomes and complication rates compared to biological prostheses, the number of scholars recommending cemented prostheses is dwindling. Faced with the challenge of ensuring biocompatibility while achieving mechanical stability, the autologous iliac bone grafting approach explored in this study is an innovative solution to this dilemma.

4.2 Unique Advantages of Autologous Iliac Bone Reconstruction

The results of this study demonstrate a high fusion rate with autologous iliac bone reconstruction of the acetabular floor. Among the 3 cases reviewed at postoperative month 3, all showed good bone graft healing. In contrast, conventional structural bone grafting often exhibits structural

discontinuity[11]. Additionally, using iliac bone for acetabular floor reconstruction better matches the anatomical morphology of the acetabulum, reducing bone loss and the proportion of bone resorption[12]. This is a significant advantage over conventional structural bone grafting. In this case series of 6 patients, no significant complications were observed. The HHS score improved from 43.5 ± 3.0 preoperatively to 87.0 ± 3.3 at postoperative month 3, achieving satisfactory outcomes. Studies by Chang Q et al. have shown that an HHS score >90 at 3 months post-primary replacement is associated with better outcomes[13]. Moreover, iliac bone harvesting is relatively easy and does not incur additional costs for patients, making it suitable for wider application.

4.3 Clinical Significance of the Study Results

This study indicates that autologous iliac bone grafting is a safe and effective technique for revising Paprosky IIC-IIIB type acetabular floor defects, offering a new option for these challenging cases. Mean intraoperative blood loss (817±37 mL) necessitates preoperative blood reserve planning, highlighting the need for blood preparation during surgery to allow for timely transfusion. Additionally, the study underscores the importance of addressing hidden blood loss after hip arthroplasty[14]. The study also revealed a significant decrease in VAS scores by postoperative day 3, facilitating early rehabilitation training.

4.4 Limitations and Future Directions

This case series study has several limitations: the small sample size (n = 6) and lack of a control group make it difficult to rule out selection bias. Additionally, 50% of the cases did not undergo follow-up for bone graft healing, which may result in an underestimation of the actual healing rate. Furthermore, the SF-36 score of 30.5 is lower than the average score of 50-60 points typically observed after primary joint replacement. Moreover, the study lacks data beyond 1 year,

precluding an assessment of long-term bone remodeling outcomes. However, the authors believe that autologous iliac bone grafting for acetabular floor defects is a valuable technique for revision hip arthroplasty, offering safety and reliability with potential for broader application.

Representative Case: A woman in her late 50s was diagnosed with postoperative pain following total hip replacement due to prosthesis loosening. The bone defect was classified as Paprosky IIIB. The preoperative pain score was 6, and the HHS score was 46. In 2024, she underwent autologous iliac bone reconstruction of the acetabular floor and hip prosthesis revision surgery. The VAS score was 2 on postoperative day 3, 1 at postoperative month 1, and the HHS score was 89 at postoperative month 3. Preoperative and postoperative radiological results are shown in Figure 2.

Figure 2: Radiological Results of the Typical Case

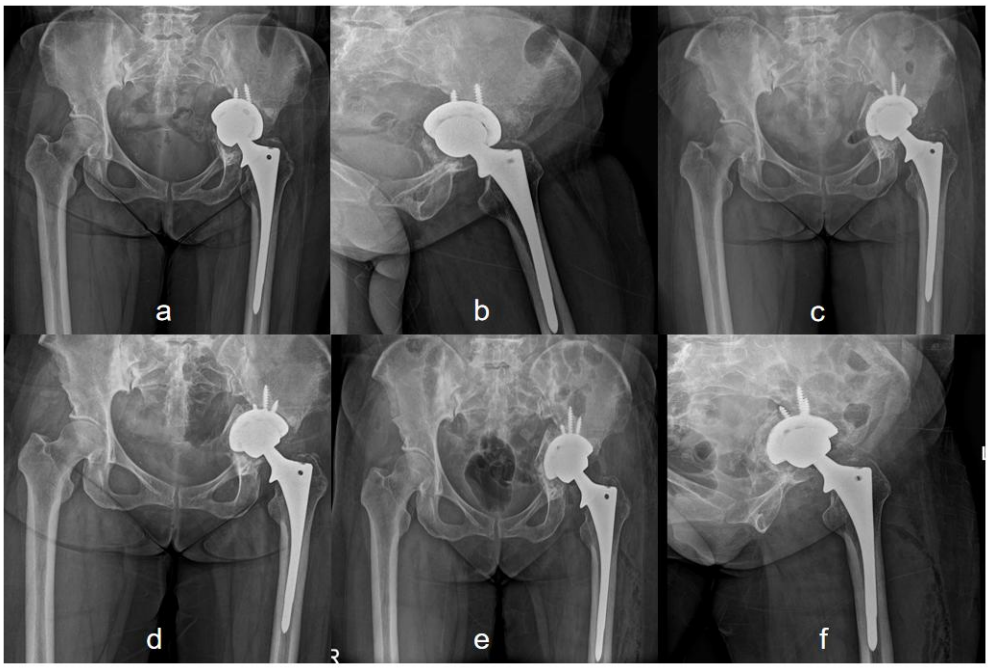


Figure Note: **a** is the preoperative AP radiograph; **b** is the preoperative lateral radiograph; **c** is the AP radiograph on the first day after surgery; **d** is the AP radiograph at 1 month after surgery;

e is the AP radiograph at 3 months after surgery; **f** is the lateral radiograph at 3 months after surgery.

5 Abbreviations

THA, total hip arthroplasty

CT, Computed tomography

MRI, Magnetic resonance imaging

HHS, Harris Hip Score

SF-36, 36-Item Short Form Survey

BMI, Body mass index

VAS, Visual Analog Scale

6 Authors' contributions

Cheng Xian, Rui Yan, collected the clinical data and drafted the manuscript. Jianyi Liu, and Yinyan Shen participated in patient management and data collection. Cheng Pang assisted with data interpretation and manuscript revision. Wei Li conceived and supervised the study, revised the manuscript, and approved the final version. All authors reviewed the manuscript.

7 Funding

No funding was received for this study

8 Acknowledgments

The authors would like to thank the patient for agreeing to the publication of this report.

9 Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

10 Clinical trial number

not applicable

11 Declarations

Ethics approval and consent to participate All procedures performed in the study were in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The review and reporting of the cases was in accordance with the ethical standards of the Ethics Committee of the First Affiliated Hospital of Guangxi Medical University (Approval number: 2024-E0964). Written informed consent was obtained from the patient for the publication of clinical data and intraoperative images.

Consent for publication not applicable.

Competing interests The authors declare no competing interests.

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