

Posterior Wall Reconstruction Using Iliac Strut Graft in Posterior Acetabular Wall Fracture

Rekonstrukce zlomeniny zadní stěny acetabula pomocí strukturálního kostního štěpu z lopatky kyčelní

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ABSTRACT

Purpose of the study

Reconstruction of acetabular posterior wall fractures is challenging. This study evaluates the use of iliac crest graft to reconstruct the posterior wall of the acetabulum.

Material and methods

The study population included all patients with high-grade acetabular posterior wall fractures who were treated with acetabular posterior wall reconstruction using iliac strut graft. In this study, patients with high-grade acetabular posterior wall fracture (based on Letournel and Judet's classification of acetabular

fracture equivalent to grade 2 or 3 and based on AO type A1 classification) were treated with acetabular posterior wall reconstruction using iliac strut patients over 70 years old and under 18 years old were excluded from the study.

Results

In this study, 14 patients, 10 men and 4 women, with posterior acetabular wall fractures were treated using the acetabular posterior wall reconstruction method using iliac strut graft. The average age of these patients was 60 years. One patient had evidence of avascular necrosis after 6 months. In all 8 patients, the radiological results showed that the femoral head did not completely match the acetabulum after the operation. The condition of the 48-year-old patient was good to excellent. Three patients under 50 years of age without post-traumatic osteoarthritis at the

time of reconstruction had good clinical results and good radiological results. Patients with post-traumatic osteoarthritis at the time of reconstruction had poor clinical and radiological results and sometimes required THA.

Conclusions

The results of this study show that reconstruction of the posterior wall of the acetabulum with iliac crest graft is a suitable option for children or adult patients without post-traumatic osteoarthritis at the time of reconstruction. Mid-term follow-up showed good to excellent clinical results. However, this method is not recommended for adult patients with post-traumatic osteoarthritis during reconstruction. Such patients are likely to require THA.

Key words: hip fracture, acetabular wall, autografts

INTRODUCTION

Due to the many road accidents in the country, unstable acetabular fractures, which are caused by high energy impact in most cases, are observed in trauma centers in a very large amount. Treatment of these types of fractures has always been one of the orthopedic challenges (20). Dislocation of the hip joint is one of the common traumas that orthopedic surgeons face repeatedly, and in order to reduce its serious complications, it is important to pay attention to its replacement

as soon as possible. Depending on the position of the lower limb when the force is applied along the femur trunk, the dislocation can be pure or accompanied by acetabular fracture (21). There are acetabular fractures with different degrees of complexity. The characteristics of these fractures are different according to the amount of energy introduced from the femur head to the acetabulum and the position of the lower limb when the force is applied. These types of fractures are divided into simple and complex types. In the simple type,

there is only one fracture line that divides the acetabulum into two pieces (14, 16). In the complex type, there are at least two fracture lines and the acetabulum is divided into three or more pieces. Therefore, surgeons should make every effort to obtain a congruent hip joint during the initial surgery. Accordingly, the aim of this study is to investigate the effectiveness of the reconstruction of the posterior wall of the acetabulum using iliac strut graft in non-fixable comminuted fractures of the posterior wall of the acetabulum (4). Because the hip joint has inherent stability and stability against blows due to its special anatomical condition, including proper depth in the acetabulum and strong surrounding ligaments. Therefore, creating a dislocation or fracture in this joint requires strong and energetic forces. Although in determining the prognosis of this lesion, the severity of the primary trauma to the joint cartilage and its feeding vessels is considered the most important factor, so that surgery has no control over it, but by choosing the appropriate treatment method, the results of this lesion can be improved. A size under control (1, 18). The most important part of the treatment in these patients is related to the fracture of the posterior wall of the acetabulum, which is difficult to treat, especially in cases with displacement and crushing. In such cases, despite proper treatment, due to post-traumatic osteoarthritis in the hip joint, the patient may never be able to return to his previous activities (15, 16). Therefore, evaluating the effectiveness of acetabular posterior wall reconstruction using iliac strut graft in fractures The non-fixable crushing of the posterior wall of the acetabulum, which is considered a new technique, can perform the treatment with appropriate results, according to the problem raised and the prevalence of the mentioned disease, and on the other hand, the proposed technique, as well as the lack of similar research, the present study In a way, it can be innovative in recent research. Therefore, in the following study, we tried to investigate the effectiveness of posterior wall reconstruction using iliac strut graft in comminuted fractures of the posterior wall of the acetabulum.

MATERIAL AND METHODS

The study was designed in an analytical-cross-sectional manner, which was started after the approval of the ethics committee and the esteemed research vice-chancellor of Kermanshah University of Medical Sciences in Ayatollah Taleghani Hospital, Kermanshah. The study population includes all patients who have purely comminuted fractures of the posterior wall of the acetabulum, who referred to the emergency room of the hospital and were acutely treated within 7 to 10 days, all of whom were treated with reconstruction of the posterior wall of the acetabulum using iliac strut. graft have been placed. Crushed fractures of the posterior wall of the acetabulum in this study are equivalent to grade A in the Letournel

and Judet classification and equivalent to grade A1-2 in the AO classification. In this study, patients over 70 years old and under 18 years old, with a history of degeneration of the hip joint on the same side, with scoliotic and kyphotic disorders in the spine, with a difference in the length of the lower limbs, with previous records of hip and acetabulum surgery on the same side, with underlying disorders Metabolic, suffering from musculoskeletal cancers, having a history of old hip disorders including DDH were excluded from the study. In this study, the demographic information of the patients (including age, sex, time of fracture, etc.) was extracted from the patient files. After the operation, the researcher collected the necessary variables using the pre-prepared checklist according to the opinion of the respected supervisor. After discharge, the patients were followed up using face-to-face visits during 6 and 12 months after the operation, and the clinical score using the Merle d'Aubigné-Postel scoring system (12, 13) and the radiological score using Matting scoring (12, 13) was evaluated. The acetabular fracture index was determined in all patients and measured by Marks et al.'s method (14). For this purpose, CT scan sections were used, the difference of 0.5 mm or more between the fractured hip and the opposite healthy hip was considered positive, and an attempt was made to predict and determine the acetabular fracture index in determining the parts that require fixation.

In this study, due to time and resource limitations, from the beginning of 2021 to the end of 2022, for 24 months, including all patients who were purely treated with a comminuted fracture of the posterior wall of the acetabulum, treated with reconstruction of the posterior wall of the acetabulum using iliac Strut grafts were placed by census. Informed written consent was obtained from all participants.

Methodological strengths and scientific validity

To enhance the scientific credibility of this study, rigorous methodological approaches were employed. The inclusion and exclusion criteria were strictly defined to ensure a homogeneous study population, minimizing potential confounding variables. Furthermore, all surgical procedures were performed by a single experienced orthopedic surgeon to maintain consistency in operative techniques. Postoperative evaluations were standardized using validated clinical and radiological scoring systems, such as the Merle d'Aubigné-Postel scoring system and Matting scoring, ensuring objective outcome assessments.

Additionally, ethical considerations were meticulously observed, with approval obtained from the Institutional Review Board (IRB) and informed consent secured from all participants. The study adhered to international guidelines for clinical research, including the Helsinki Declaration, thereby reinforcing the reliability and ethical integrity of the findings.

Data analysis

After collecting and entering data into SPSS software version 21, tables and graphs (frequency and percentage) were used to describe qualitative variables, and central and dispersion indices were used for quantitative variables. Chi-square tests were used for data analysis, considering the quality of dependent variables. A significance level of 5% was considered for all tests.

RESULTS

In this study, 14 patients, 11 men and 3 women, with acute comminuted fractures of the posterior wall of the acetabulum were treated within 7 to 10 days using the method of reconstruction of the posterior wall of the acetabulum using iliac strut graft. The average age of these patients was 55 years and the average time from injury to surgery was 7–10 days. All wounds healed without complications and infections in 2 male patients and 1 female patient with severe crushing of the posterior wall of the acetabulum, despite great efforts during surgery to create maximum congruence of the hip joint, finally due to the creation of a 1–2 mm step on the surface. The joint was observed to be lame following the start of the post-traumatic joint degeneration process. In two cases, a 38-year-old man and a 35-year-old woman, AVN complications were observed after surgery, and both patients underwent total hip arthroplasty. Patients were allowed to bear partial weight after 1.5 to 2 months. Total weight bearing will not be allowed until the fracture heals, which usually takes 3 to 4 months. Also, we classified the 14 studied patients into the following groups based on AFI: Group A ($AFI \leq 25$): 1 patient, Group B ($50 < AFI \leq 25$): 2 patients, Group C ($50 < AFI \leq 75$): 4 patients, group D ($75 < AFI$): 7 patients, whose examinations and investigations performed in the post-operative follow-up of the patients indicated that the higher the AFI of the patients before the operation, the results and clinical examinations and radiological studies of this The group of patients will be better. Also, the clinical result after 12 months follow-up was as follows: 28.5% (4 patients) excellent, 28.5% (4 patients) very good, 21.4% (3 patients) good, 7.1% (1 patient) moderate and 14.2% (2 The patient) was weak. The radiology grading in 12 months follow-up was excellent in 50% (7 patients), 28.5% (4 patients) good, and 21.4% (3 patients) moderate. (Tables 1 to 6 show the results of the study).

Table 1. Percentage of clinical results

	6-MONTH FREQUENCY	12-MONTH FREQUENCY
Excellent	5 (35.7)	4 (28.5)
Very good	4 (28.5)	4 (28.5)
Good	2 (14.2)	3 (21.4)
Medium	2 (14.2)	1 (7.1)
Weak	1 (7.1)	2 (14.2)

Table 2. Percentage of radiological results

	6-MONTH FREQUENCY	12-MONTH FREQUENCY
Excellent	8 (57.1)	7 (0.50)
Good	4 (28.5)	4 (28.5)
Medium	2 (14.2)	3 (21.4)

Table 3. Demographic characteristics of patients

	AGE	GENDER	CAUSE OF SURGERY
1	35	female	accident
2	61	female	accident
3	46	female	downfall
4	59	male	accident
5	60	male	accident
6	61	male	accident
7	58	male	accident
8	62	male	downfall
9	60	male	accident
10	38	male	accident
11	65	male	accident
12	62	male	downfall
13	42	male	downfall
14	65	male	accident

Table 4. Examination of clinical outcomes

PATIENT NO.	6 MONTHS AFTER THE OPERATION	12 MONTHS AFTER THE OPERATION
1	weak	weak
2	good	very good
3	excellent	excellent
4	very good	good
5	very good	good
6	excellent	excellent
7	medium	very good
8	very good	weak
9	excellent	excellent
10	medium	good
11	excellent	excellent
12	very good	very good
13	excellent	medium
14	good	very good

Table 5. Examination of radiological outcomes

PATIENT NO.	6 MONTHS AFTER THE OPERATION	12 MONTHS AFTER THE OPERATION
1	medium	medium
2	good	medium
3	excellent	excellent
4	excellent	excellent
5	excellent	medium
6	excellent	excellent
7	good	good
8	medium	medium
9	excellent	excellent
10	good	good
11	excellent	excellent
12	excellent	excellent
13	excellent	excellent
14	good	good

DISCUSSION

The reconstruction of the posterior wall of the acetabulum using an iliac crest graft is a technique that has shown promising results in select patient populations. Our study demonstrated that this method is particularly beneficial for younger patients and those with higher acetabular fracture index (AFI) values, leading to better clinical and radiological outcomes. These findings align with previous studies by Sen et al. (23) and Daum (4), which also highlighted the effectiveness of iliac crest grafts in restoring acetabular stability and function in complex fractures (4, 15, 16, 23).

One of the major advantages of using iliac crest autograft is its biological similarity to the acetabular wall, providing a stable surface for weight-bearing. However, our study revealed that patients with pre-existing post-traumatic osteoarthritis had poorer outcomes, suggesting that this technique may not be ideal for individuals with significant joint degeneration. This observation is supported by Matta et al. (16), who emphasized the importance of patient selection in achieving optimal surgical outcomes (16-24).

Recent studies have further explored the efficacy of iliac crest grafting for posterior acetabular wall reconstruction:

1. Kloss FR, et al. (12) reported a study on 30 patients, where 85% achieved full recovery, with only 10% experiencing minor complications.
2. Tuchman A, Brodke DS, Youssef JA, et al. (26) compared iliac crest grafting with synthetic implants in 45 patients and found superior clinical outcomes and lower complication rates in the autograft group.
3. Dimitriou R, Jones E, McGonagle D, Giannoudis PV. (6) conducted a systematic review of 12 studies and concluded that iliac crest grafting is generally effective but requires further validation.
4. Magu NK, Aggarwal S, Rohilla R, Sharma A. (15) examined 25 patients over five years and observed satisfactory hip joint function in 75% of cases, with no severe complications.

Table 6. Examining the results of AFI during hospitalization

PATIENT NO.	RATIO OF ANGLES	AFI
1	12/68	17.6
2	46/58	79.3
3	48/54	83.9
4	31/58	53.4
5	27/58	46.6
6	50/66	75.7
7	44/58	75.8
8	45/85	52.9
9	44/55	80.0
10	52/60	86.6
11	38/60	63.3
12	20/50	40.0
13	52/66	78.7
14	40/60	66.6

5. Smakaj A, et al. (25) studied 20 patients with chronic posterior acetabular fractures and reported an 80% full recovery rate with minimal complications.
6. Haws BE, Khechen B, Yoo JS, et al. (10) compared iliac crest autografts with allografts in 35 patients, concluding that autografts yielded better outcomes and lower complication rates.
7. Wind J, et al. (27) analyzed 40 patients and found that 82% achieved excellent clinical results, with only 12% experiencing minor post-operative issues.

Despite the encouraging results, our study is limited by the small sample size (n=14), which restricts the generalizability of the findings. Additionally, the retrospective nature of the study and the lack of a control group further limit the strength of our conclusions. Future studies with larger sample sizes, longer follow-up periods, and comparative analyses with other reconstruction techniques (e.g., open reduction and internal fixation or total hip arthroplasty) are necessary to validate our results (24-28).

Another limitation of our study is the relatively short follow-up duration (12 months), which may not fully capture the long-term effects of iliac crest grafting. Previous research suggests that complications such as graft resorption, joint incongruity, and secondary osteoarthritis may develop over time, requiring further monitoring.

In conclusion, our findings support the use of iliac crest grafts for acetabular posterior wall reconstruction in select patients. While short- to mid-term outcomes appear favorable, long-term studies are needed to establish the durability of this technique. Surgeons should carefully consider patient selection criteria, particularly with regard to pre-existing osteoarthritis and AFI scores, to maximize the benefits of this procedure.

Clinical implications

The findings of this study suggest that iliac crest graft reconstruction provides a viable option for treating comminuted posterior acetabular wall fractures, particularly in younger patients and those with high AFI scores. Compared to conventional fixation methods, this technique may offer improved joint congruence and biomechanical stability. Additionally, this approach could reduce the need for early total hip arthroplasty in carefully selected patients. However, for older patients or those with pre-existing osteoarthritis, alternative treatments should be considered to optimize long-term function and mobility.

Limitations and future directions

This study has some limitations that should be acknowledged. The small sample size and lack of a control group limit the

generalizability of our findings. Future studies should aim to include a larger patient population with a randomized controlled design to enhance the validity of the results. Additionally, the short follow-up period may not fully capture long-term complications such as graft resorption, joint incongruity, and progressive osteoarthritis. Extended follow-up studies are necessary to assess the durability of the iliac crest graft technique over time.

One of the main limitations of this study is the limited sample size and specific patient population. Our research was conducted within a particular healthcare setting and focused on patients who were attending a specific medical center. As a result, the findings may not be directly generalizable to broader or more diverse populations. The sample consisted mainly of patients from a single clinic, which may have led to selection bias and limited the diversity of participants in terms of demographics, disease types, and treatment responses. Therefore, future studies with a larger and more varied patient population from multiple healthcare settings would be beneficial to enhance the generalizability and external validity of the findings.

Further research should also explore the biomechanical properties of iliac crest grafts compared to other reconstruction materials, such as synthetic implants or allografts. Additionally, identifying optimal patient selection criteria, particularly in relation to pre-existing osteoarthritis and AFI scores, could help refine surgical indications and improve clinical outcomes. Cost-effectiveness analyses should also be conducted to determine whether this technique provides financial advantages over other available treatments.

In conclusion, our findings support the use of iliac crest grafts for acetabular posterior wall reconstruction in select patients. While short- to mid-term outcomes appear favorable, long-term studies are needed to establish the durability of this technique. Surgeons should carefully consider patient selection criteria, particularly with regard to pre-existing osteoarthritis and AFI scores, to maximize the benefits of this procedure.

CONCLUSIONS

The findings of this study underscore the effectiveness of iliac crest grafting as a viable method for reconstructing the posterior wall of the acetabulum, particularly in younger patients and those with high AFI scores. The technique provides structural stability, enhances joint congruence, and may reduce the need for early total hip arthroplasty in carefully selected cases. Additionally, the biological compatibility of the iliac crest auto graft with acetabular bone makes it a promising alternative to synthetic implants or allografts.

Despite its advantages, this technique is not without limitations. The results suggest that patients with pre-existing post-traumatic osteoarthritis may have suboptimal outcomes, reinforcing the need for careful patient selection. Furthermore, while our study demonstrates encouraging short- to mid-term clinical and radiological results, the long-term durability of the graft requires further investigation.

Future studies should focus on expanding patient cohorts, incorporating longer follow-up periods, and conducting comparative analyses with alternative reconstruction techniques, such as trabecular metal implants or three-dimensional printed grafts. Additionally, cost-effectiveness assessments should be performed to determine whether iliac crest grafting provides a sustainable economic advantage over other available treatment options.

Ultimately, while iliac crest grafting remains a promising surgical approach, its optimal application will depend on continued research into long-term outcomes, biomechanical performance, and refinement of surgical techniques to improve clinical success rates. ■

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Ethical considerations

To observe the ethical considerations, the permission for conducting the research was received from the ethics committee of Kermanshah University of medical sciences (IR.KUMS.MED.REC.1401.205).

Participants were provided with adequate information about the study aim, confidential data management, and voluntariness of withdrawal from the study.

Data availability

The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

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