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Original Article

Core decompression, allogenic fibula fixation, and pedicled fibula grafting are effective for osteonecrosis of femoral head

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Abstract: Objective: To explore the application effects of core decompression, allograft fibula fixation, and pedicled fibula grafting in osteonecrosis of the femoral head (ONFH). Methods: Forty patients with ONFH admitted to Ziyang Central Hospital from March 2017 to March 2022 were included in this study. According to the Association Research Circulation Osseous (ARCO) staging criteria, 20 patients at stage I underwent core decompression, 8 patients at stage II underwent core decompression combined with allogenic fibula fixation, and 12 patients at stage III underwent core decompression combined with pedicled fibula grafting. Results: After 1 year of follow-up, changes in hip joint function (Harris score) and pain level (visual analogue scale (VAS)) were compared before and after surgery. Imaging examination results were recorded, and efficacy and ARCO stage progression were compared with preoperative findings. All 40 patients received follow-up for 1 year. The results showed that the Harris score at 1 year post-operation was higher than pre-operation, while the VAS score was lower ($P<0.05$). Hip joint function evaluation in the 20 patients at stage I showed excellent, good, and fair results in 12 (60.00%), 5 (25.00%), and 3 (15.00%) cases, respectively, with X-ray examination indicating complete stability and no progression in ARCO staging. Among the 8 patients at stage II, hip joint function evaluation showed excellent, good, fair, and poor results in 4 (50.00%), 2 (25.00%), 1 (12.50%), and 1 (12.50%) cases, respectively. X-ray examination revealed stability in 7 cases, while 1 case progressed to ARCO stage IV and ultimately required artificial hip arthroplasty. Among the 12 patients at stage III, hip joint function evaluation revealed excellent, good, fair, and poor results in 5 (41.67%), 3 (25.00%), 2 (16.67%), and 2 (16.67%) cases, respectively. X-ray examination indicated stability in 10 cases, while 2 cases progressed to ARCO stage IV and ultimately required artificial hip arthroplasty. Conclusion: Patients with stage I, II, and III ONFH achieved good short-term therapeutic outcomes using core decompression, core decompression with allogenic fibula fixation, and core decompression with pedicled fibula grafting. These methods effectively improved hip joint function and alleviated pain symptoms. Hence, it is crucial to select appropriate surgical methods based on the specific conditions of patients in clinical practice.

Keywords: Core decompression, allogenic fibula fixation, pedicled fibula grafting, osteonecrosis of femoral head, ARCO staging

Introduction

Osteonecrosis of the femoral head (ONFH) is a degenerative disease caused by a variety of factors [1]. The main pathological changes include osteonecrosis, destruction of the bone structure, and a lack of trabecular support [2]. The pathogenesis of ONFH involves multiple factors such as vascular insufficiency, mechanical stress, and metabolic disturbances. In severe cases, the osteomechanical strength of the bone may be compromised, leading to collapse under stress. This can result in long-term damage to the hip joint, impair weight-bearing and walking function, and reduce the quality of life of patients [3].

The treatment for ONFH is primarily surgical, supplemented by symptomatic management of bone changes. The objective of early treatment is to decompress the subchondral bone, stimulate bone repair and reconstruction, restore mechanical support to the articular surface, preserve hip function, extend the lifespan of

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Table 1. Comparison of Harris score and visual analogue scale (VAS) score before and after operation ($\bar{x}\pm s$, score)

Parameters	Before operation	1 year after surgery	t	P
Stage I (n=20)				
Harris	69.84±11.25	87.62±10.49	5.168	0.000
VAS	4.76±1.02	1.97±0.64	10.345	0.000
Stage II (n=8)				
Harris	65.26±12.04	88.19±12.76	3.697	0.002
VAS	5.27±1.16	2.13±0.72	6.519	0.000
Stage III (n=12)				
Harris	60.48±11.75	85.63±12.91	4.991	0.000
VAS	5.59±1.48	2.11±0.68	7.405	0.000

the affected femoral head, and delay the need for hip replacement [4]. Core decompression, bone grafting (with or without a vascular pedicle), vascular bundle implantation, stem cell transplantation, osteotomy, and other treatment methods have demonstrated varying degrees of effectiveness in managing ONFH [5-9], with different methods yielding distinct curative effects and complications. Core decompression is one of the most commonly used techniques for treating ONFH, particularly during the early stages. This procedure aims to reduce intraosseous pressure, promote angiogenesis, and facilitate bone repair by removing necrotic tissue and creating pathways for new blood vessel formation [10, 11]. During more advanced stages, however, additional interventions such as allogenic fibula fixation or pedicled fibula grafting may be required to provide mechanical stability and enhance bone regeneration [12, 13].

Our study was driven by the need to evaluate the effectiveness of various surgical approaches in managing ONFH across different stages. Specifically, we aimed to assess the therapeutic outcomes of simple core decompression, core decompression combined with allogenic fibula fixation, and core decompression with pedicled fibula grafting. Through a retrospective analysis of patients treated between March 2017 and March 2022, we sought to identify the optimal surgical methods for each stage of ONFH, thereby enhancing patient outcomes. Our findings will offer evidence-based insights into the application and efficacy of specific surgical interventions, so as to inform clinical practice and guide future research directions in this field.

Materials and methods

Case selection

Data of 40 patients with ONFH admitted to our hospital from March 2017 to March 2022 were included in this retrospective analysis. The cohort included 26 men and 14 women, with ages ranging from 20 to 58 years (median age: 37 years). The disease duration ranged from 1 to 12 months, with a median duration of 6 months. Among the cases, 32 patients had unilateral disease, and 8 had bilateral disease. Based on the International Society for the Study of Bone Circulation (ARCO) staging, there were 20 cases at stage I, 8 cases at stage II, and 12 cases at stage III (Supplementary Data 1, 2, 3). The identified pathogenic factors included alcohol use in 22 cases, hormonal causes in 12 cases, trauma in 4 cases, and idiopathic origins in 2 cases.

This study received approval from the Institutional Review Board and Ethics Committee of Ziyang Central Hospital. As the study exclusively utilized de-identified patient data, with no potential harm or impact on the patients, the requirement for informed consent was waived. This waiver was granted by the Institutional Review Board and Ethics Committee in accordance with the regulatory and ethical standards governing retrospective research studies.

Inclusion criteria: 1) Fulfillment of the relevant diagnostic criteria outlined in the *Expert Consensus on Clinical Diagnosis and Treatment Technique of Osteonecrosis of the Femoral Head (2022 edition)*; 2) Age ≥18 years; 3) Effective removal of the patient's pathogenic factors; 4) Preoperative X-ray, CT, and/or MRI examinations of both hip joints; 5) A minimum follow-up period of 1 year post-surgery to evaluate short-term therapeutic effects; 6) Availability of all necessary data required for this study.

Exclusion criteria: 1) ARCO stage >IIIB or joint surface involvement area >15%; 2) Presence of other hip joint diseases such as rheumatoid arthritis, ankylosing spondylitis, or developmental dysplasia of the hip; 3) History of prior hip surgeries or significant hip trauma that could confound the evaluation of ONFH treatment outcomes; 4) Diagnosis of malignant

Table 2. Follow-up results of patients with different stages of ONFH

Stage	Number of Patients	Hip Function Evaluation	X-ray Examination	ARCO Stage Progression
I	20	Excellent: 12 (60.00%) Good: 5 (25.00%) Fair: 3 (15.00%)	All stable	No progression
II	8	Excellent: 4 (50.00%) Good: 2 (25.00%) Fair: 1 (12.50%) Poor: 1 (12.50%)	Stable: 7 Progressed to IV: 1	Progressed to IV: 1 (12.50%) Artificial hip replacement: 1
III	12	Excellent: 5 (41.67%) Good: 3 (25.00%) Fair: 2 (16.67%) Poor: 2 (16.67%)	Stable: 10 Progressed to IV: 2	Progressed to IV: 2 (16.67%) Artificial hip replacement: 2

ONFH, osteonecrosis of femoral head; ARCO, Association Research Circulation Osseous.

tumors; 5) Severe organ diseases, endocrine disorders, or coagulation abnormalities; 6) Presence of mental illness impeding normal communication; 7) Patients who were excessively obese or had known allergies; 8) Pregnant or breastfeeding women.

Intervening methods

The 20 patients at stage I underwent core decompression. Patients were under continuous epidural or general anesthesia, positioned supine with the hips slightly elevated on the operative side and the femoral neck parallel to the operating table. The procedure was performed under the guidance of a C-arm X-ray machine. A longitudinal incision of 4-6 cm was made on the lateral side of the medial line of the lower trochanter of the femur. Subcutaneous tissue and deep fascia were incised sequentially to control bleeding. The deep muscle tissue was bluntly dissected and retracted to expose the lateral side of the femur. A guide needle was drilled 1.5 cm below the apex of the greater trochanter into the femoral head cartilage along the central axis of the femoral neck. C-arm fluoroscopy confirmed the guide needle's location in the necrotic area. An 8 mm hollow drill was used to penetrate the femoral head along the guide needle, and fluoroscopy verified it reached 0.5 cm below the cartilaginous surface of the femoral head. Necrotic tissue was scraped, and the guide needle was redirected to decompress additional areas in front of and below the primary decompression zone. The guide needle and hollow drill were withdrawn, and bone marrow samples were collected for pathological examination. A drainage strip was inserted, and the incision was sutured in layers. Postoperatively, patients were advised to use double crutches, engage in early active functional exercises, and avoid weight-bearing or long-distance walking. The decision to discontinue crutch use was based on follow-up evaluations.

For the 8 patients at stage II, core decompression with fibular allograft support was performed. The core decompression procedure followed the method described previously. Long strips of autogenous cancellous bone were harvested from non-necrotic areas for grafting. Reheated, fat-free allograft fibula was prepared by cutting it into segments, along with a small amount of allograft cancellous bone, which was also shaped into strips. The allograft fibula segments were carefully inserted into the bone grafting area of the femoral head through the decompression channel created in the core. Excess fibula was removed as needed, followed by irrigation of the surgical site and closure of the incision with sutures. Postoperative care included functional exercises and activity restrictions as described for the core decompression procedure.

The 12 patients at stage III received core decompression with pedicled fibula grafting. A 12-15 cm incision was made 3-4 cm below the small head of the fibula, on the lateral side of the middle and upper third of the calf, along the axial line of the fibula toward the lateral ankle. The fascia and muscle tissue were separated to expose the fibula. A segment of fibula with a 10-12 cm pedicle was cut transversely 5 cm below the small head of the fibula. The blood vessels were preserved and ligated to stop bleeding, and the nourishing vessels were maintained to protect the proximal vascular

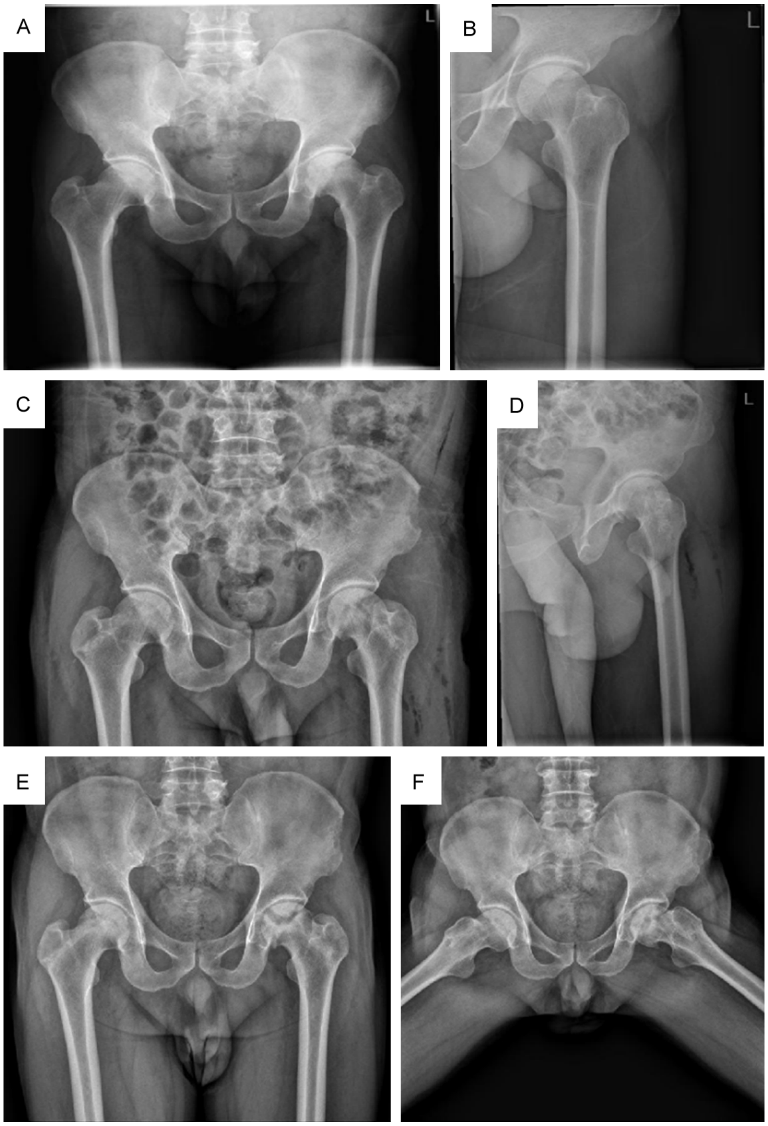

Figure 1. X-ray images of case 1. A, B. Preoperative anteroposterior and lateral X-ray images revealed a diagnosis of Association Research Circulation Osseous (ARCO) stage I ONFH in both hips. C, D. Anteroposterior and lateral X-ray images taken 3 days post-surgery showed bone tunnels from the decompression of the medullary core in both hips, along with signs of bone graft particles in the necrotic area of the femoral head and within the bone tunnel. E, F. One year after surgery, the anteroposterior and frog-leg position X-ray images demonstrated that the femoral head in the right hip remained intact, with visible signs of bone fusion in the bone graft area. However, the left hip exhibited a necrotic area with a low-density shadow around it, suggesting possible collapse of the necrotic region.

pedicle. The fibula with the vascular pedicle was wrapped in warm gauze for later use. Using the direct anterior approach, the joint capsule at the hip joint was incised to remove inflammatory tissue, growths, damaged bursae, and other pathological formations. A groove was created in the anterolateral bone cavity of the femoral neck, which was then cleaned. Cancellous bone from the iliac crest was grafted into the cavity, and the distal end of the pedicled fibula was inserted into the femoral head cavity. The peel surface of the fibula's periosteum was closely affixed to the bony groove of the femoral neck, and the transplanted fibula was secured using absorbable screws. The fibular arteriovenous anastomosis was made to the flexor arteriovenous. The incision was cleaned, a drainage tube was inserted, and the wound was sutured in layers. Postoperative functional exercises followed the same protocol as described previously.

Data collection

Patients were followed for 1 year to observe the therapeutic effects. The Harris Hip Score system was used to assess hip function before and after surgery, evaluating factors such as pain, deformity, range of motion, use of walking aids, and walking distance. The total score is 100, with a higher score indicating better hip function. Scores of 90 or above were considered excellent, with no joint pain; scores between 80 and 89 were considered good, with mild discomfort and essentially unrestricted movement; scores between 70 and 79 indicated mild hip pain; and scores below 70 indicated severe hip pain or restricted joint movement. The Visual Analogue Scale (VAS) was used to assess pain levels. A 10 cm line was drawn, with 0 representing no pain and 10 representing the worst possible pain. Patients were asked to mark the line according to their own perception of pain. Higher scores indicated more severe pain. Imaging evaluations were based on the X-ray

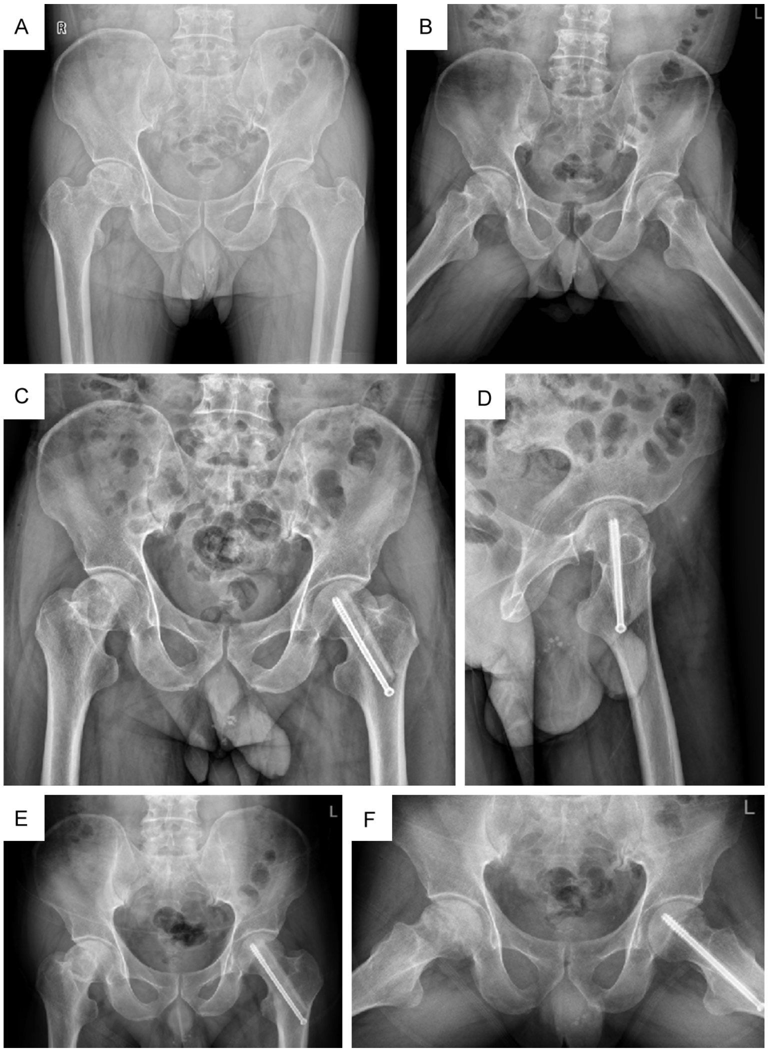

Figure 2. X-ray images of case 2. A, B. Preoperative X-position and frog position films showed that the preoperative diagnosis stage of the patient was ARCO II on both sides. C, D. Anteroposterior and lateral X-ray images 2 days after surgery showed accurate support position of the left hip allograft fibula flap, good location of the hollow nail, and accurate fixation. E, F. One year after surgery, the anteroposterior and frog position X-ray images showed that the patient's left hip showed the allograft fibula flap and hollow nail in good position, the femoral head was intact, and the bone graft area showed signs of bone fusion.

assessment criteria developed by Chen [14]. The criteria include evaluation of the femoral head shape before and after treatment, bone density improvements in the necrotic area, blurring of the sclerotic zone, and the stability or improvement of the ARCO stage. If the femoral head collapsed, joint hyperplasia occurred, or artificial hip replacement was needed, the condition was considered worsened, and the ARCO stage was considered progressive, indicating failure of the surgical treatment.

Outcome measurements

Primary indicator: Radiographic evaluation.

Secondary indicators: Harris score and VAS score.

Statistical methods

Statistical analysis was performed using SPSS 21.0 software. Count data were expressed as percentages (%), and measurement data that followed a normal distribution were expressed as mean ± standard deviation ($\overline{x}\pm s$). A paired sample t-test was used to compare preoperative and postoperative values within the same group. A *P*-value of less than 0.05 was considered statistically significant.

Results

Comparison of Harris score and VAS score before and after operation

All 40 patients were follow-up for more than 1 year. The Harris score was significantly higher, and the VAS score was significantly lower 1 year after surgery compared to preoperative values ($P<0.05$), as shown in **Table 1**.

Hip function of patients at different stages

Hip function evaluation in the 20 patients at stage I showed excellent, good, and fair results in 12 (60.00%), 5 (25.00%), and 3 (15.00%) cases, respectively. X-ray examination showed stability in all the cases, and no progression in the ARCO stage (**Table 2**).

Hip function evaluation of the 8 patients at stage II showed excellent, good, fair, and poor results in 4 (50.00%), 2 (25.00%), 1 (12.50%), and 1 (12.50%) cases, respectively. X-ray examination showed stability in 7 cases, and 1 case

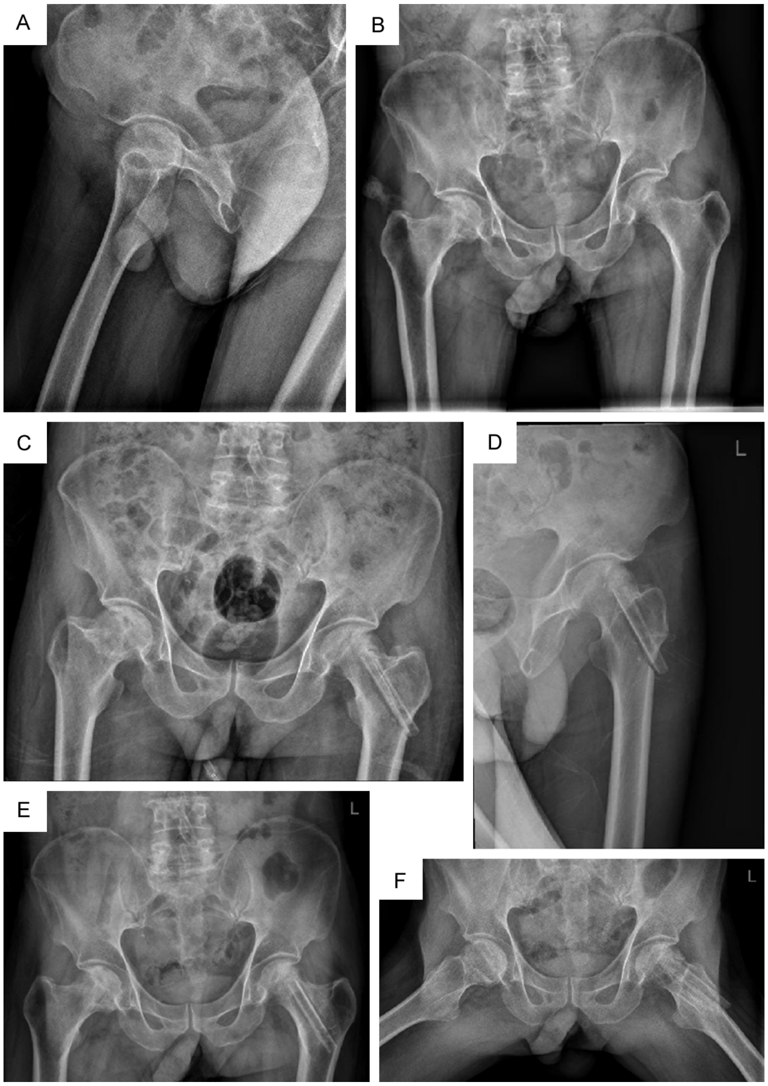

Figure 3. X-ray images of case 3. A, B. Preoperative anterior-lateral X-rays showed that the diagnostic stage was ARCO IIIA on the right side and ARCO II on the left side. C, D. Anteroposterior and lateral X-ray images 3 days after surgery showed that the support position of the left hip autopedicled fibula flap was accurate, and bone graft particles were visible in the necrotic area of the femoral head and were effectively supported. E, F. One year after surgery, the anteroposterior and frog position X-ray images showed that the fibula flap of the patient's left hip was well positioned, the femoral head was intact, and the bone graft area in the femoral head showed increased density and signs of bone fusion.

advanced to stage IV according to the ARCO classification, ultimately undergoing artificial hip replacement.

Hip function evaluation of the 12 patients at stage III revealed excellent, good, fair, and poor results in 5 (41.67%), 3 (25.00%), 2 (16.67%), and 2 (16.67%) cases, respectively. X-ray examination showed stability in 10 cases, and 2 cases advanced to stage IV according to the ARCO classification. Ultimately, artificial hip replacement was performed.

Typical cases

Case 1: A 52-year-old male diagnosed with bilateral femoral head necrosis underwent core decompression of the femoral head and autogenous bone compression with bone grafting on both hips (**Figure 1**).

Case 2: A 40-year-old male was diagnosed with bilateral femoral head necrosis. The patient's right hip was not treated for hip preservation, while the left hip was treated with femoral head core decompression, allograft fibula, and hollow nail support (**Figure 2**).

Case 3: A 38-year-old male was diagnosed with bilateral femoral head necrosis. No hip preservation treatment was performed on the right hip. The patient underwent femoral head core decompression and pedicled fibula flap transplantation on the left hip. The fibula flap was taken from the same side of the body, and fibula arteriovenous anastomosis with the lateral transverse branch being performed during the operation (**Figure 3**).

Case 4: A 40 years old male, with necrosis of the left femoral head, underwent femoral head core decompression and pedicled fibula flap transplantation. The fibula flap with pedicled was taken from the same side of the body during the operation, and the fibula arteriovenous anastomosis with the lateral transverse branch arteriovenous anastomosis was performed (**Figure 4**).

Case 5: A 47-year-old male was diagnosed with necrosis of the right femoral head. He under-

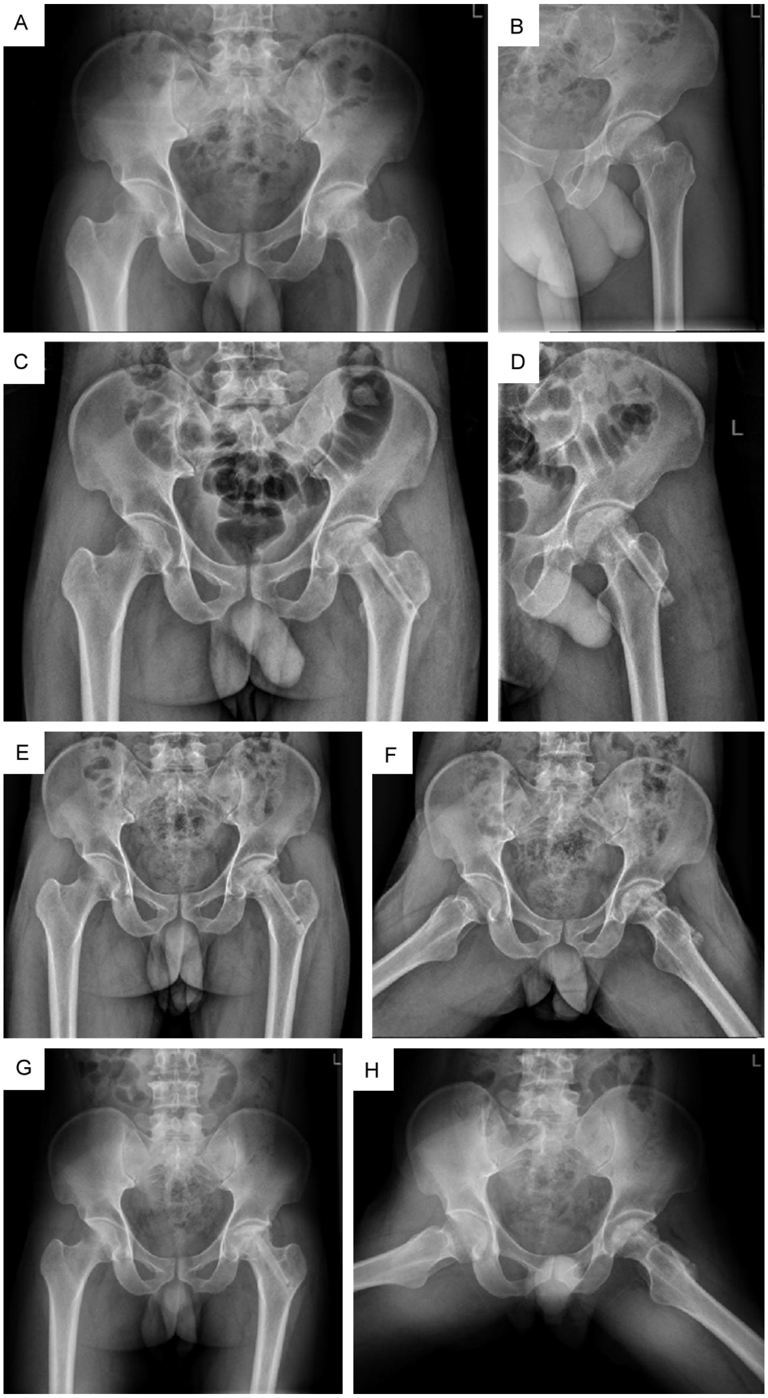

Figure 4. X-ray images of case 4. A, B. Preoperative anterior-lateral X-rays showed that the diagnostic stage was left ARCO stage II. C, D. Anteroposterior and lateral X-ray images 3 days after surgery showed that the support position of the left hip autopedicled fibula flap was accurate, and bone graft particles were visible in the necrotic area of the femoral head, and the necrotic area was effectively supported. E, F. One year after surgery, the anteroposterior and frog position X-ray images showed that the fibula flap of the patient's left hip was well positioned, the femoral head was intact, and the bone graft area in the femoral head showed increased density and signs of bone fusion. G, H. 2 years after surgery, the anteroposterior and frog position X-ray images showed slight collapse of the left femoral head, significantly increased density and signs of bone fusion in the bone graft area of the femoral head.

went femoral head core decompression and pedicled fibula flap transplantation. The fibula flap was taken from the same side of the body during the operation, and fibula arteriovenous anastomosis with the lateral transverse branch was performed (**Figure 5**).

Case 6: A 38-year-old male was diagnosed with bilateral femoral head necrosis. No hip preservation treatment was performed on the right hip. The patient underwent femoral head core decompression and pedicled fibula flap transplantation on the left hip. The fibula flap was taken from the same side of the body during the operation, and fibula arteriovenous anastomosis with the lateral transverse branch was performed (**Figure 6**).

Discussion

ONFH is a type of hip joint disease with a high disability rate. Its pathogenic factors are complex, the pathogenesis remains unclear, and the main clinical treatment focuses on symptomatic management to delay disease progression. If left untreated, femoral head collapse may occur, impairing hip function and potentially progressing to the advanced stage, which requires artificial hip replacement [15-19]. Given the limited lifespan of artificial hips, young patients may require multiple surgeries to maintain normal hip function, creating a significant economic burden [20, 21]. ONFH presents substantial challenges in both diagnosis and treatment, especially for younger patients who may need repeated interventions. Effective early-stage treatments are essential to

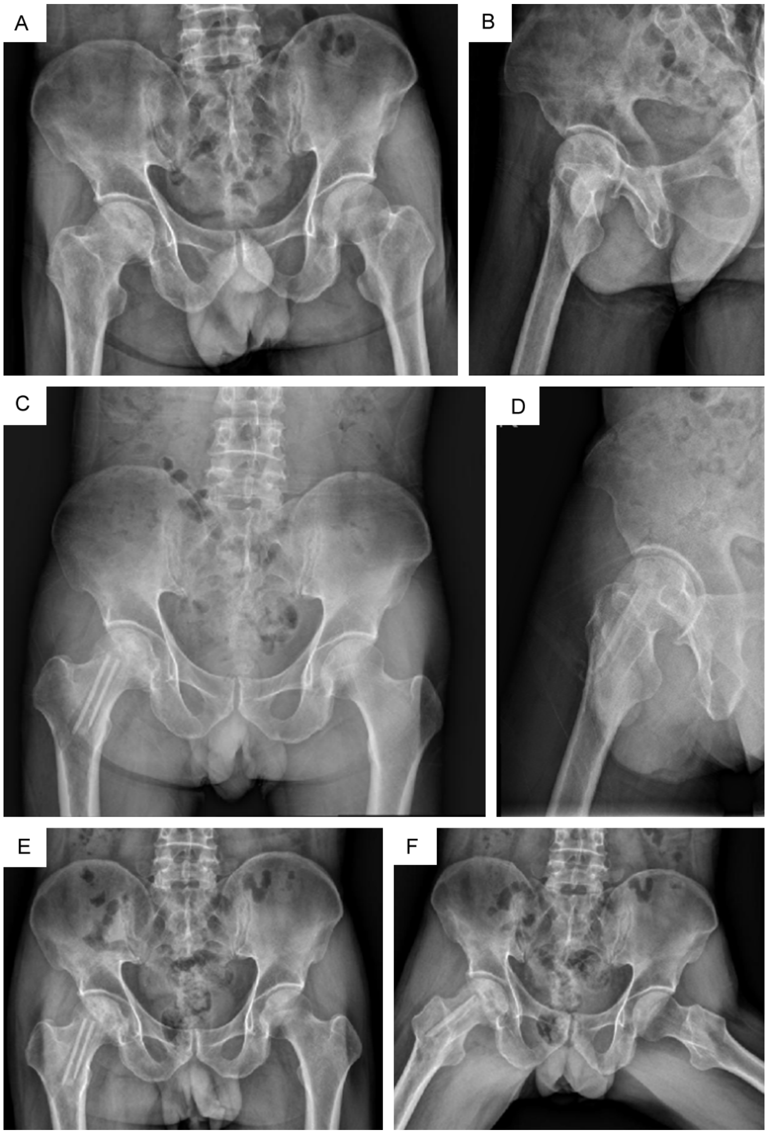

Figure 5. X-ray images of case 5. A, B. Preoperative anterior-lateral X-rays showed that the diagnostic stage was ARCO II on the right side. C, D. Postoperative anterolateral X-rays showed that the support position of the auto-pedicled fibula flap of the right hip joint was accurate, and bone graft particles were visible in the necrotic area of the femoral head. The fibula flap was slightly short, and the necrotic area was still effectively supported. E, F. One year after surgery, the anteroposterior and frog position X-ray images showed that the fibula flap of the right hip was well positioned, the femoral head was intact, and the density of the bone graft area in the femoral head was unevenly increased, with signs of bone fusion.

prevent disease progression and reduce the need for hip replacements.

This study included 40 patients with ARCO stage I, stage II, or stage III. Three treatment methods were adopted: simple core decompression, core decompression + allograft fibula support, and core decompression + pedicled fibula transplantation, all of which achieved good therapeutic outcomes. Core decompression was used to treat early-stage ONFH. The physical effects of intraosseous hypertension were reduced through drilling to open closed interosseous chambers and remove necrotic bone, alleviating bone marrow stasis caused by compression. This process blocked the vicious cycle between intraosseous hypertension and pathological changes in bone marrow microcirculation [22]. Additionally, angiogenesis at the decompression hole increases blood circulation within and around the femoral head, facilitating the restoration of normal microcirculation and gradually improving the hemorheology within the bone. Once a new balance in the intraosseous environment is established, the occurrence of intraosseous hypertension can be prevented, even if the decompression hole closes [23, 24]. The results of the 1-year follow-up in this study showed that hip function and pain symptoms were effectively improved in stage I patients, with an excellent and good rate of 85%. No progression in the ARCO stage was observed, confirming that simple core decompression for early ONFH can achieve good short-term benefits in hip function and pain relief without disease progression. This approach offers a viable option for managing early-stage ONFH.

Bone transplantation can be categorized into two types: with and without a vascular pedicle. Bone transplantation without a vascular pedicle includes both autologous and allogeneic

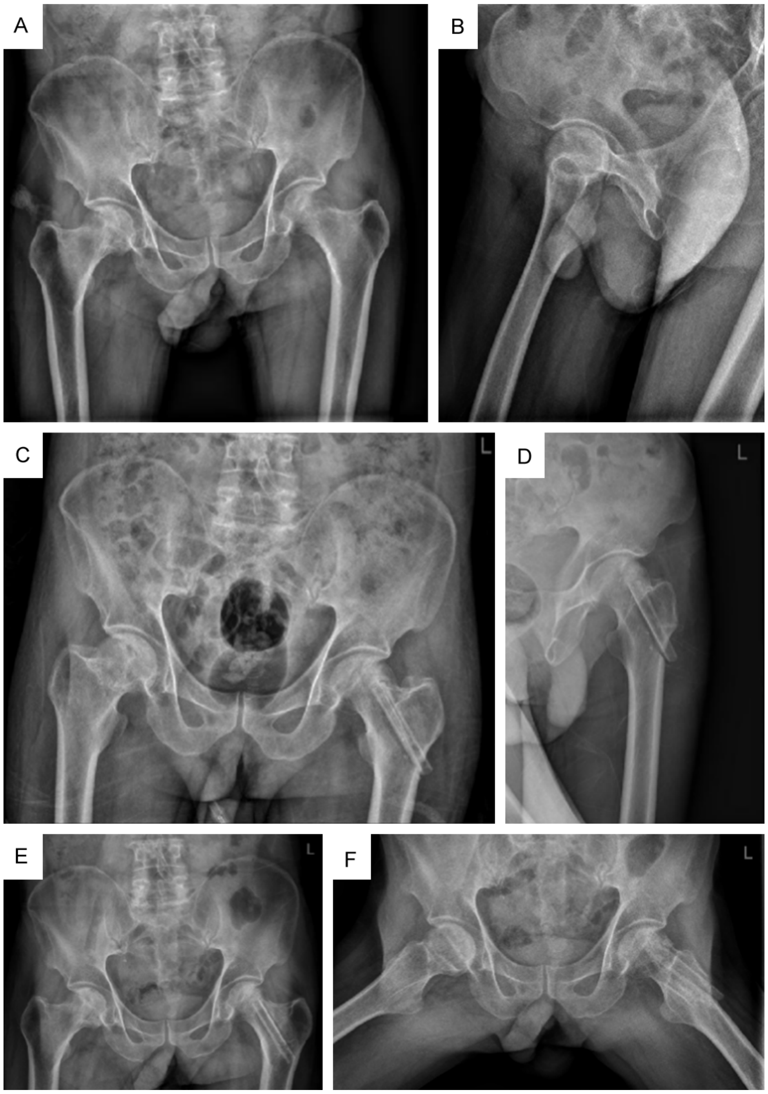

Figure 6. X-ray images of case 6. A, B. Preoperative anterior-lateral X-rays showed that the diagnostic stage was ARCO II on both sides. C, D. Anteroposterior and lateral X-ray images 3 days after surgery showed that the support position of the left hip autopedicled fibula flap was accurate, and bone graft particles were visible in the necrotic area of the femoral head, and the necrotic area was effectively supported. E, F. One year after surgery, the anteroposterior and frog position X-ray images showed that the fibula flap of the patient's left hip was well positioned, the femoral head was intact, and the bone graft area in the femoral head showed increased density and signs of bone fusion.

bone transplantation, with fibula bone being a commonly used allograft option [25]. The entire bone grafting process is guided by C-arm fluoroscopy, which helps avoid the scraping of normal bone tissue while removing necrotic bone. Additionally, fluoroscopy enables direct observation of the degree of contact between the implanted bone and the bone cavity wall [26]. In this study, fibula allograft implantation served to fill the bone cavity, support the femoral head, and maintain its shape [27]. The use of autogenous and allogeneic cancellous bone, after compression and tamping, allowed for a close connection with the cavity wall, ensuring better filling of the bone cavity. This helped to reinforce the subchondral bone, effectively preventing and correcting femoral head collapse [28]. At the same time, it distributed stress at the femoral head and neck, reducing the risk of fractures caused by stress concentration [29-31]. The results of the 1-year follow-up showed that pain symptoms were significantly relieved in stage II patients, and hip function was notably restored. The excellent and good rate of hip function reached 75%. This confirms that core decompression combined with allograft fibula support can improve the condition of ONFH in the short term. However, 1 patient did progress to ARCO stage IV and eventually opted for artificial hip replacement. Therefore, while core decompression with allograft fibula support is effective in improving hip function and alleviating pain in stage II ONFH patients, some cases may still progress to more advanced stages.

With the development and widespread use of microsurgical techniques, vascular pedicle bone transplantation has become a widely applied clinical approach. The fibula flap transplantation, which is the most common and successful procedure for ONFH, has proven particularly effective [32, 33]. Clinically, it is believed that bone transplantation with a vascular pedicle helps to reconstruct the blood supply of the femoral head, while simultaneously providing mechanical support. When combined with core decompression, it can delay disease progression. However, this procedure requires microsurgical skills for vasostomy, which is technically demanding, time-consuming, and carries an increased risk of trauma. In this study, stage III patients underwent surgery performed by experienced surgeons, and a 1-year follow-up demonstrated that the surgical intervention achieved good therapeutic outcomes. Pain and hip dysfunction were effectively improved. The excellent and good rate of hip joint function reached 66.67%, with 2 patients progressing to ARCO stage IV and requiring artificial hip replacement. Vascular pedicle bone transplantation offers a promising treatment option for stage III ONFH by providing both mechanical support and improved blood supply. While it produces positive results, it is important to carefully consider the technical complexity of the procedure and the possibility of disease progression.

While our study provides valuable insights into the therapeutic effects of different surgical interventions for ONFH, several limitations should be considered when interpreting our findings. First, the sample size was relatively small (n=40), which limits the statistical power and may not fully represent the broader ONFH patient population. A larger, multicenter study would enhance the generalizability of these results and provide more robust evidence. Additionally, the follow-up period of one year is insufficient to assess the long-term outcomes and durability of the surgical treatments. Extended follow-up is essential to evaluate the sustained effectiveness of these interventions and to identify potential delayed complications or disease progression. Patients were categorized into different stages of ONFH based on the ARCO classification, but there may still be variability within each stage. Factors such as the underlying etiology of the disease, comorbidities, and baseline health status could influence treatment outcomes. Future studies should aim to control for these variables to provide a clearer understanding of their impact on the efficacy of surgical interventions.

In summary, for patients with stage I, II, and III ONFH, the treatment methods of simple core decompression, core decompression with allograft fibula support, and core decompression with pedicled fibula transplantation have demonstrated good short-term therapeutic effects. These interventions effectively improve hip joint function and alleviate pain symptoms. Clinically, the choice of surgical approach should be tailored to the individual patient's condition. In cases where the disease progresses significantly, artificial hip replacement may be considered as an alternative treatment.

Disclosure of conflict of interest

None.

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