CLINICAL ARTICLE

Surgical Treatment of Internal Fixation Failure of Femoral Peritrochanteric Fracture

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Objective: To investigate the factors, surgical treatment methods and clinical effect of internal fixation failure of intertrochanteric and subtrochanteric fractures.

Methods: From June 2015 to May 2019, arthroplasty and internal fixation revision were used to treat 18 cases of internal fixation failure of intertrochanteric and subtrochanteric fractures. There were 10 males and eight females, with an average age of 67.3 years (38–92 years). The 16 cases of initial intertrochanteric fractures were classified according to AO/OTA:13 cases of A2 and 3 cases of A3, the other 2 cases were subtrochanteric fractures (Seinsheimer type IV). The internal fixation failure was treated with total hip arthroplasty (6 cases), bipolar hemiarthroplasty (4 cases), revision with proximal femoral lockingplate (4 cases) and extend intramedullary nail (4 cases).

Results: All patients were followed up for an average of 24.7 months (range, 12 to 36 months). The average operative time was 111.4 min (range, 72 to 146 min) and the average intraoperative blood loss was 403.6 mL (range, 200 to 650 mL). The average time of fracture union was 6.9 months (range, 5 to 9 months) for cases of internal fixation revision. The operative time of the arthroplasty group was shorter than the revision group ($P < 0.001$), and the intraoperative blood loss of the arthroplasty group was less than the revision group ($P = 0.001$). The affected limb shortening of postoperative (0.21 ± 0.19 cm) was better than preoperative (2.01 ± 0.60 cm) ($P < 0.001$), while the limb shortening of the arthroplasty group (0.11 ± 0.21 cm) was less than the revision group (0.33 ± 0.09 cm) ($P = 0.015$). At the last follow-up, all injured limbs regained walking function, and the Harris hip score was 81.3 ± 9.4 points. The Harris score of postoperative was better than preoperative (33.4 ± 5.9 points) ($P < 0.001$), while there were no significant differences between the arthroplasty group and the revision group at 3 months (76.5 ± 8.5 *vs* 71.1 ± 10.6, $P = 0.249$), 6 months (80.9 ± 7.9 *vs* 78.9 ± 12.9,$P = 0.687$) postoperative and the last follow-up (80.5 ± 8.3 *vs* 82.3 ± 11.7, $P = 0.716$) respectively.

Conclusion: For internal fixation failure of peritrochanteric fractures, young patients could accept internal fixation revision to restore normal anatomical structure, correct varus deformity and autograft; while elderly patients and patients with damaged femoral head could be treated with arthroplasty to restore walking function.

Key words: Arthroplasty; Failure; Intertrochanteric fracture; Revision; Subtrochanteric fracture

Introduction

Hip fractures occur in a large number of elderly patients, with 1.6 million fractures worldwide annually and a projected increase to over 6 million hip fractures per year by 2050[1]. Hip fractures are divided into two categories according to the anatomical location of fractures: intracapsular and extracapsular fractures. Femoral neck fractures are classified as intracapsular fractures and peritrochanteric fractures including intertrochanteric and subtrochanteric fractures as extracapsular fractures. The

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intertrochanteric zone is regarded as the region from extracapsular femoral neck to the distal of the lesser trochanter, while the subtrochanteric area is defined as the area from the lesser trochanter extending 5 cm distally. Intertrochanteric fractures most frequently caused by low energy trauma like falls from standing height in elderly patients with osteoporosis, accounting for nearly half of all hip fractures; while subtrochanteric fractures account for approximately 25% of all hip fractures, caused by high-energy trauma in young patients and leading to relatively complex fracture pattern, or relating to pathological fractures and osteoporosis in elderly patients which frequently associated with spiral fracture configurations[2,3]. All peritrochanteric fractures, whether intertrochanteric or subtrochanteric in fracture area, should accepted surgical treatment if the patient's general condition is stable enough to survive the anesthesia and surgery. Surgical intervention as soon as possible after preoperative safety preparation will allow early mobilization and reducing morbidity and mortality.

Correct selection of implant contributes to improving the clinical effect and reducing internal fixation failure of peritrochanteric fractures. A variety of extramedullary and intramedullary implants are available for intertrochanteric fractures such as dynamic hip screw, 95° blade plates, proximal femoral locking plate (PFLP) and intramedullary nails. All above implants can be used for stable intertrochanteric fractures[4–6]. Intramedullary nails can be minimally invasive to reduce bleeding, achieve earlier mobilization and weight-bearing, especially for weak or incomplete lateral wall, small trochanteric displacement, posteromedial cortical comminuted, the fracture line extending to subtrochanteric and reverse intertrochanteric fracture[7–9]. For these reasons, intramedullary nails are recommended for unstable intertrochanteric fractures[5,10–12]. The risk of failure following subtrochanteric fractures is obvious higher than intertrochanteric for high concentration of stresses on the subtrochanteric region. Intramedullary nails have several biomechanical advantages over extramedullary implants for subtrochanteric fractures, including a shorter lever arm, better loading and less bending movement across the fracture site and implant[13].

With the increasing cases of internal fixation in peritrochanteric fractures, failure occurs occasionally. Incidence of implant failure of PFLP for these fractures varies from 0% to 41% in the literature[14,15]. With intramedullary nails of peritrochanteric fractures, also comes complications such as failure of reduction, cut-out, displacement by nail insertion and shaft fracture, although the cited rate complication (9% to 14%) is lower than PFLP[16–18]. The main factors of internal fixation failure were poor bone quality, unfavorable fracture patterns, inappropriate choice of internal fixation devices, unsatisfactory reduction quality, and improper implant position[19,20]. Failure of the treatment of peritrochanteric fractures would cause severe persistent pain and remarkable disability, leading to various higher complications and poor prognosis, consequently necessitating surgical intervention again. There were many difficulties that may affect the clinical effect of the reoperation, including distorted soft tissue anatomy, residual bone deformity, broken implants, poor bone quality and femoral deficiency. Some technical challenges include a difficult surgical exposure, removal of the broken implants, correction of collodiaphyseal angle and varus deformity, anatomical reduction of the fracture, bone grafting to improving the vascularity biology of the fracture and firm prolonged immobilization. Accordingly, management of these patients has been reported with increased risks of perioperative morbidity, prolonged operative times, escalated blood loss, frequent intraoperative fracture, and a high rate of early dislocation[21,22]. Many factors should be consideration when making the decision to perform internal fixation revision or arthroplasty: proximal femoral bone stock, competency of the hip joint, patient physiological age, live expectancy, initial fracture pattern and femoral head intact or not[23–25]. Femoral head preservation with internal fixation revision is preferable for young patients with long life expectancy and enough femoral quality for fixation. On the contrary, for geriatric population which is debilitated and accompanied with many comorbidities, hip arthroplasty is beneficial for early weight bearing, accelerating hip functional recovery and eliminating the risk of fracture nonunion[25,26].

Over the past decade, several valuable surgical strategies had been proposed for the salvage of failed internal fixation of intertrochanteric and subtrochanteric fractures, there are still some issues worthy deep discussion. To our knowledge, there were few reports which compared the clinical effect between these two treatment methods in internal fixation failure of peritrochanteric fractures. In this study, 18 cases of internal fixation failure of peritrochanteric fractures were retrospectively reviewed. Our aims were: (i) to analyze the factors of internal fixation failure of peritrochanteric fractures; (ii) to summarize the clinical effect of reoperation for internal fixation failure of peritrochanteric fractures; and (iii) to compare the clinical effect between arthroplasty and internal fixation revision for the failure of peritrochanteric fractures.

Methods

Subjects

The inclusion criteria for enrolling patients were as follows: (i) patients diagnosed with internal fixation failure of intertrochanteric and subtrochanteric fractures; (ii) patients treated with arthroplasty and internal fixation revision; (iii) postoperative follow up no less than 12 months; (iv) postoperative radiological and clinical results were required; and (v) a retrospective study. In contrast, the exclusion criteria were: (i) peri-implant intertrochanteric refracture caused by various trauma recently; (ii) the hip combined with rheumatoid arthritis, osteoarthritis, femoral bone tumor; and (iii) patients accompanied with

comorbidities which would significantly influence the rehabilitation.

A retrospectively review of patient files and operation logs between June 2015 to May 2019 was performed. We treated 18 cases of internal fixation failure of intertrochanteric and subtrochanteric fractures with arthroplasty and internal fixation revision. There were 10 males and eight females, with an average age of 67.3 years (38–92 years). There were 10 cases on the left side and eight on the right side. The causes of initial fractures were as follows: 12 cases, fall from height standing; three cases, fall from a height and the other three cases were injured in traffic accidents. A total of 16 cases of initial intertrochanteric fractures were classified according to the classification of AO/OTA: 13 cases of A2 and three cases of A3, the other two cases were subtrochanteric fractures (Seinsheimer type IV). Two patients were accompanied with distal radius fracture and one with acute brain injury. The initial fixation methods were intramedullary nail in 16 cases and PFLP in two cases. The performance of internal fixation failure was as follows: screw blade cut-out in four cases and cut- through in three cases, intramedullary nail rapture in six cases, PFLP rapture in two cases and femoral head avascular necrosis in three cases. This study was approved by the hospital ethics committee and all cases signed the ethical informed consent after admission.

Preoperative Management

All patients had accepted X-ray examination of pelvis and injured hip. Computer tomography scan with coronal and sagittal plane reconstruction are recommended to understand the condition of initial peritrochanteric fractures. D-dimer and vascular ultrasound are usual in diagnosing deep vein thrombosis in the lower extremity. We had used a tape to measure the shortening length of affected lower limb in all patients. Inflammatory indicators such as blood routine examination, C-reactive protein and erythrocyte sedimentation rate were performed to exclude concomitant infection. The average interval between intramedullary nail failure and injured was 13.8 months (range, 6–57 months). All patients accepted the first failure surgery except one patient which had been experienced two internal fixation revision surgery.

Surgical Strategy

The patients were positioned in supine or lateral position on a radiolucent operating table under lumbar epidural or general anesthesia. An imaging intensifier was used throughout the intraoperative procedure. Posterolateral approach was used for arthroplasty and lateral approach was used for internal fixation revision. First of all, we removed the original internal fixation. Removing distal segment of the broken intramedullary nails may be difficult sometimes and required special instruments and strategies. Total hip arthroplasty (6 cases) and bipolar hemiarthroplasty (4 cases) were carried out as usual procedures. Protecting gluteus medius tendinous attachment and reconstructing the greater trochanter were essential for abductor function. Revision with PFLP (4 cases) and extension of the intramedullary nail (4 cases) should be reduced anatomically or to slight valgus alignment. Varus reduction was not acceptable. For seven cases of internal fixation revision, the skin incision was routinely extended to the ipsilateral iliac crest for iliac crest autograft. Free vascularized fibular grafting was used for the patient who experienced two revisions before admitted to our hospital.

Postoperative Management

Routine antibiotics was used to prevent incision infection. Physical and chemical deep venous thrombosis prophylaxis were administered for all patients. Active ankle and tor functional exercises and quadriceps femoris contraction exercises should be start as soon as possible after recovery from anesthesia. All arthroplasty patients except one intraoperative femoral shaft fracture were encouraged to commence full weight-bearing immediately. The patients revision with intramedullary and PFLP were encouraged to exercise but not full weight-bearing on the second day after surgery. We suggested that patients started full weight-bearing exercise usually 3 months after surgery when X-ray radiographs showed blurred fracture lines and callus formation.

Follow-up was performed at 1, 2, 3, 4, 5, 6, 9, 12 months after operation and once every 6 months thereafter. We advised the patients to do functional exercises. X-rays of pelvis and affected hip were taken to evaluate the position of prosthesis and internal fixation, fracture healing, the presence of infection and loosening of implant.

Outcome Measure

The operative time and intraoperative blood loss were recorded. The preoperative and postoperative shortening of affected limbs were measured through the distance between the anterior superior iliac spine and medial malleolus. The fracture healing time was determined by clinical physical examination and X-rays showing blurred callus in fracture area. Physical examination and X-rays in the follow-up were analyzed whether there were prosthesis loosening and displacement.

Harris Hip Score

The Harris hip score (HHS) was used to evaluate the hip function after surgery which was comprised of pain, function, absence of deformity, and range of movement. The maximum score is 100 points, of which the pain domain contributes 44, function 47, range of movement 5 and absence of deformity 4 points. A total score < 70 is considered a poor score, 70–80 fair, 80–90 good and 90–100 excellent[27].

Complication

Intraoperative complications like femoral shaft fracture and postoperative complications including incision infection, internal fixation failure again, prosthesis loosening and

TABLE 1 Clinical result between the arthroplasty group and the internal fixation revision group

Groups	Intraoperative blood loss (mL)	Operative time (min)	Shortening of affected limb postoperative (cm)	HHS at 3 m postop (points)	HHS at 6 m postop (points)	HHS at the last follow-up (points)
Arthroplasty group ($n = 10$)	327.5 ± 81.7	96.8 ± 14.5	0.11 ± 0.21	76.5 ± 8.5	80.9 ± 7.9	80.5 ± 8.3
Revision group ($n = 8$)	498.8 ± 97.3	129.8 ± 13.8	0.33 ± 0.09	71.1 ± 10.6	78.9 ± 12.9	82.3 ± 11.7
t value	4.063	4.884	2.721	1.196	0.410	0.370
P value	0.001	<0.001	0.015	0.249	0.687	0.716

displacement, femoral head necrosis and severe pain of the injured hip were recorded and analyzed.

Statistical Analysis

The paired *t*-test was used to compare the difference between preoperative and postoperative shortening of affected limb, preoperative and at the last follow-up HHS. The *t*-test of group design was used to compared the operative time, intraoperative blood loss, shortening of affected limb and HHS between arthroplasty group and internal fixation revision group. We analyzed these data by SPSS 24.0 (IBM, Armonk, NY, USA) statistics software. $P < 0.05$ was considered statistically significant.

Results

Follow-up

All patients were followed up for an average of 24.7 months (range, 12 to 36 months) as a result. The averaged time of fracture union was 6.9 months (range, 5 to 9 months) for cases of internal fixation revision.

Operative Time

The average operative time was 111.4 ± 21.2 minutes. The operative time of arthroplasty group was 96.8 ± 14.5 minutes and internal fixation revision group was 129.8 ± 13.8 minutes respectively. The operative time of arthroplasty group was shorter than revision group, and there was significant difference in the two groups ($t = 4.884$, $P < 0.001$).

Intraoperative Blood Loss

The averaged intraoperative blood loss was 403.6 ± 119.4 mL. The intraoperative blood loss of arthroplasty group (327.5 ± 81.7 mL) was less than internal fixation revision group (498.8 ± 97.3 mL), and there was significant difference in this two groups ($t = 4.063$, $P = 0.001$).

Shortening of Affected Limb

The shortening of affected limbs preoperative and postoperative were 2.01 ± 0.60 cm and 0.21 ± 0.19 cm, respectively. Compared to the preoperative, postoperative shortening of affected limb is significantly decreased ($t = 12.134$, $P < 0.001$). The shortening of affected limb of the arthroplasty group (0.11 ± 0.21 cm) was less than the revision group (0.33 ± 0.09 cm), and there was significant difference in these two groups ($t = 2.721$, $P = 0.015$).

Harris Hip Score (HHS)

The averaged HHS increased from 33.4 ± 5.9 points preoperative to 81.3 ± 9.4 points in the last follow-up ($t = 18.311$, $P < 0.001$). The results were classified as excellent in two cases, good in 11, fair in two, and poor in three, with the excellent and good rate of 72.2%.

There were no significant differences between the arthroplasty group and the revision group at 3 months (76.5 ± 8.5 *vs* 71.1 ± 10.6, $t = 1.196$, $P = 0.249$), 6 months (80.9 ± 7.9 *vs.* 78.9 ± 12.9, $t = 0.410$, $P = 0.687$) postoperative and last follow-up (80.5 ± 8.3 *vs* 82.3 ± 11.7, $t = 0.370$, $P = 0.716$) respectively. See details in Table 1.

Three representative cases were present in Figs. 1–3.

Complications

There were no complications such as incision infection, internal fixation failure again, prosthesis loosening and displacement, or femoral head necrosis in the follow-up. One case of hemiarthroplasty had intraoperative femoral shaft fracture at the distal of the prosthesis stem, which was replaced with la ong femoral stem and immobilized with cerclage wires. One case had prosthesis dislocation 3 weeks after total hip arthroplasty and no more dislocation occurred after manual reduction and conservative treatment. A patient with intramedullary nail revision noted obvious discomfort when prolong activity and had poor joint function, the HHS was 54 points.

Discussion

Factors of Inter Fixation Failure

Intramedullary nail was widely used to treat peritrochanteric fractures, and the failure after intramedullary nail fixation was not uncommon, accounting for up to 13.23% of all unstable intertrochanteric fracture treatment with cephalomedullary nails[28]. Failed treatment of an intertrochanteric fracture typically leads to severe functional disability and pain, especially in elderly patients[7,29]. The main factors for intramedullary nail failure were poor bone quality, unfavorable fracture patterns, inappropriate choice of internal fixation devices, unsatisfactory reduction quality, or improper implant position[23–26]. Previous studies reported that varus deformity arose from initial primary reduction and cut-out of the screw were the typical failure

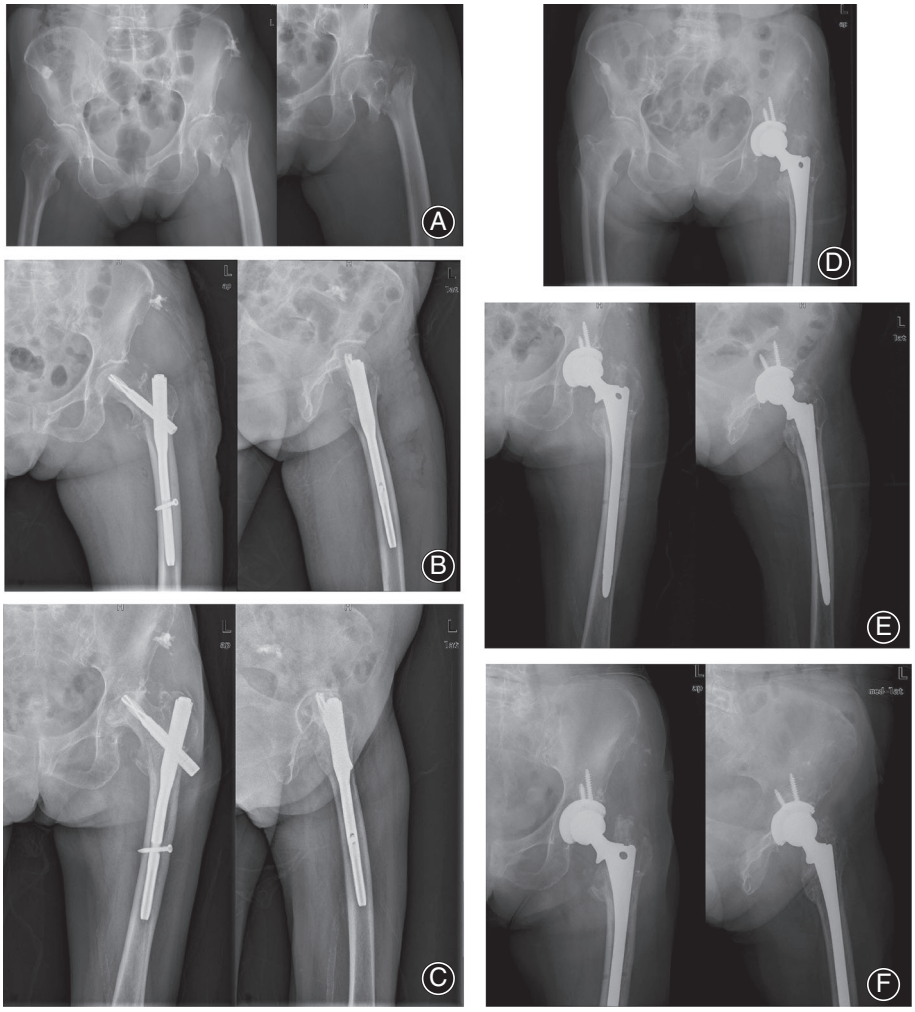

Fig. 1 A 76-year-old female patient with initial left intertrochanteric fracture (type A2) 14 months after fixation with proximal femur nail anti-rotation (PFNA) accepted total hip arthroplasty (THA) for initial fixation failure. (A) Preoperative anteroposterior X-rays of pelvic and injured hip. (B) Anteroposterior and lateral X-rays at immediate after the internal fixation of PFNA. (C) Anteroposterior and lateral X-rays at 14 months after fixation of PFNA, showed femoral head necrosis. (D) Anteroposterior X-ray of pelvic at immediate after THA. (E) Anteroposterior and lateral X-rays of the hip at immediate after THA. (F) Anteroposterior and lateral X-ray films of the hip at 3 months after THA.

pattern after intramedullary fixation for proximal femur fractures[30–32]. Many risk factors have been proposed as the reason for PFLP failure including female sex, elderly, malposition of the plate, poor bone quality and malreduction of the fracture[33].

Hsu *et al.* analyzed 136 cases of intertrochanteric fractures and considered that sex, tip-apex distance (TAD) and the entry point of the nail has been shown to be associated with failure. Female, the distance from the piriformis fossa to the greater trochanteric tubercle >6 mm, TAD >25 mm were the independent factors in contributing to intramedullary nail fixation[28]. Zhang *et al.* analyzed 22 failure cases in 204 intertrochanteric fractures after fixation with proximal femoral nail antirotation and concluded that achieving a good quality of reduction and central blade position on lateral hip X-rays were essential for avoiding mechanical failure, however, TAD did not effectively predict mechanical failure in their study[34].

In our study, screw blade cut-out in four cases and cut-through in three cases, intramedullary nail rapture in six cases, PFLP rapture in two cases and femoral head avascular necrosis in three cases. What is more, metabolic bone disease and metastatic disease were high risk factors for breakage of the implant[31,35].

Hip Arthroplasty

For elderly patients with failed peritrochanteric fractures, arthroplasty was usually the main treatment method because it allowed the patient to start full weight-bearing exercise after surgery and avoid the process of initial nonunion fractures. Total hip arthroplasty was the best choice for femoral head necrosis after internal fixation for 3three cases in our study. Min proposed a new protocol based on the bone condition of the femoral head rather than patient age for failed internal fixation for intertrochanteric fracture, when the femoral head had been destroyed hip arthroplasty should been performed[36]. D'Arrigo *et al.* reported 21 patients with a mean age of 75.8 years were treated with hip arthroplasty for failed treatment of proximal femoral fracture including 19 cases of total hip arthroplasty and two cases of bipolar hemiarthroplasty, and suggested that for elderly patients with poor bone quality and initial fracture pattern, hip arthroplasty may be a reliable treatment for failed proximal femoral fractures[37].

Paying attention to deal with some challenges include broken hardware, deformity, femoral bone defects can

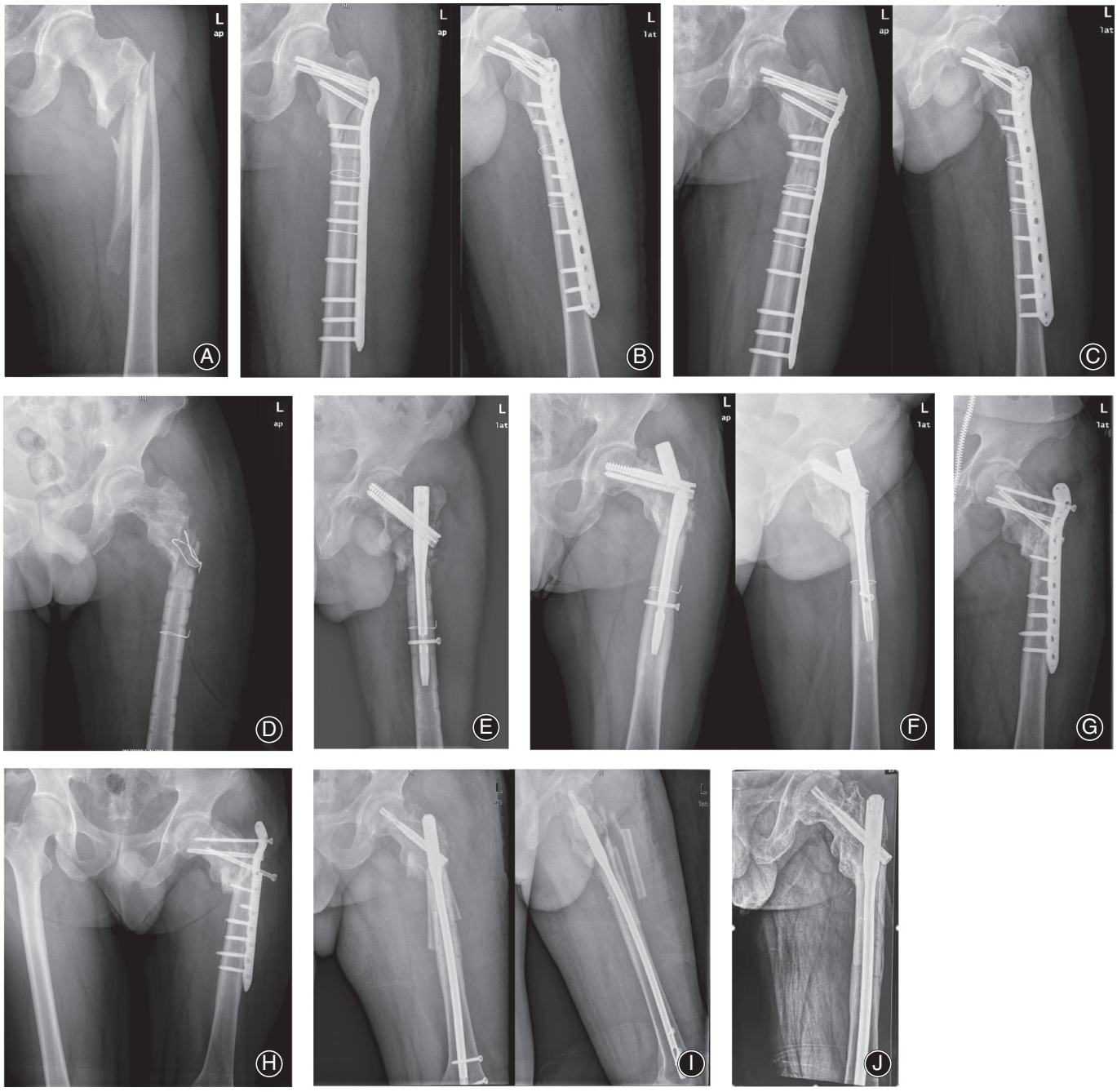

Fig. 2 A 50-year-old male patient with initial left subtrochanteric fracture (Seinsheimer type IV). (A) Preoperative anteroposterior X-ray of injured hip. (B) Anteroposterior and lateral X-rays at immediate after the initial internal fixation of PFLP. (C) Anteroposterior and lateral X-rays after 6 months showed the fracture had not healed and PFLP had loosened. (D) Remove of the PFLP. (E) The first revision surgery with InterTan and autograft. (F) Anteroposterior and lateral X-rays of hip showing the InterTan had broken 2 years after the first revision. (G) The second revision with PFLP and autograft. (H) The PFLP had broken 6 months after the second revision. (I) Anteroposterior and lateral X-rays of the third revision with PFNA and free vascularized fibular grafting. (J) Anteroposterior X-ray of at 24 months after the third revision, showed the fracture had healed.

minimize potential complications[38,39]. Nonunion of the great trochanteric fracture was common, and reconstruction of the greater trochanter was required before insertion of the prosthetic stem. Protecting the gluteus medius tendinous attachment was essential for hip abductor function. Proximal bone loss, bone deformity and compromised proximal bone

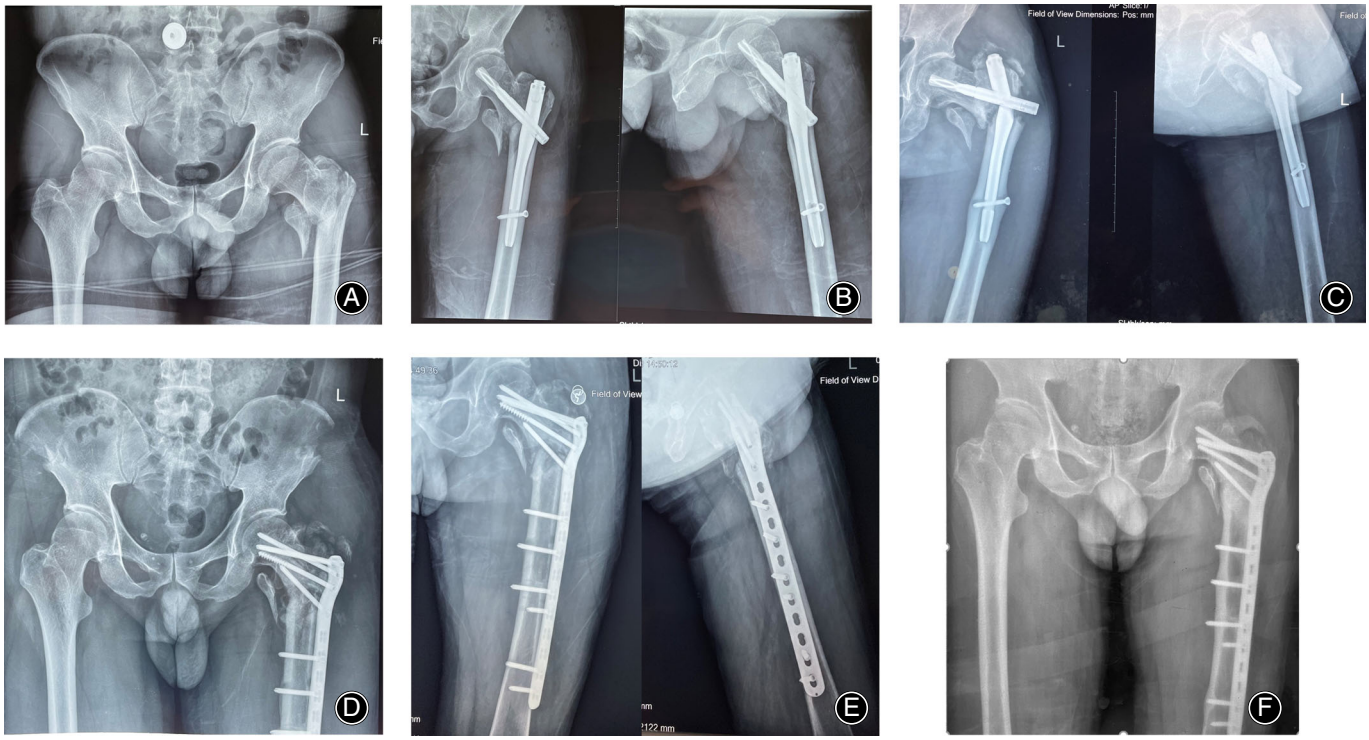

Fig. 3 A 52-year-old male patient with initial left intertrochanteric fracture (type A2) 18 months after fixation with PFNA accepted the second surgery with PFLP revision for the failure of initial fixation. (A) Preoperative anteroposterior X-ray of pelvic. (B) Anteroposterior and lateral X-rays at immediate after the internal fixation of PFNA. (C) Anteroposterior and lateral X-rays at 18 months after fixation of PFNA, showed the failure of PFNA. (D) Anteroposterior X-ray of pelvic at 3 months after revision with PFLP. (E) Anteroposterior and lateral X-rays of the hip at 6 months after revision with PFLP. (F) Anteroposterior and lateral X-rays of the hip at 2 years months after revision, showed the fracture had healed.

quality limit implant fixation options and can contribute to intraoperative distal femoral shaft fractures during canal preparation and insertion of the prosthetic stem[37]. In our study, a case of hemiarthroplasty had intraoperative femoral shaft fracture at the distal of prosthesis stem when insertion of the stem, which was replaced with long-stem and immobilized with cerclage wires at last. Restoring the limb length was important because many patients had significant limb shortening before surgery, the shortening of affected limbs in the arthroplasty group was successfully corrected to 0.11 cm in our study.

Revision with Internal Fixation

For internal fixation failure of peritrochanteric fractures in young patients without a femoral head broken, revision with PFLP or extending the intramedullary nail was a preferable choice. Tucker *et al.* described 20 cases of cephalomedullary nail failure that were treated with revision cephalomedullary nails, PFLP, long-stem or restoration arthroplasty or endoprosthesis[40]. They concluded that there was no reported evidence on the best clear functional benefit for managing the failed intramedullary nail, with no clear functional benefit in the options above, good surgical technique is critical in the initial surgery. Benz *et al.* reported 13 patients presenting with inter and subtrochanteric femur fractures, nonunion or implant failure were managed with exchange intramedullary nailing, locking compression plates and biological supplementation[41]. Fracture union occurred at a mean of 9 months post revision surgery in all patients. They thought internal fixation revisions for implant failure were an effective technique to restore anatomy, maintain function and facilitate immediate weight bearing.

There were some difficulties with the treatment process for failed peritrochanteric fractures for deformation of fracture area, bone defect, consequent concentration of varus stress, even removal of the broken intramedullary nails[25,42]. Because varus deformity will increase stress in the region of the femoral head, restoring anatomical alignment of proximal femur or correcting into slight valgus was an important principle in achieving fracture union[43]. What is more, debridement of fibrous tissue and autografting should not be ignored. In our study, seven cases of autogenouscancellous bone grafting taken from ipsilateral iliac bone and one case of free vascularized fibular grafting were performed and contributed to fracture union in the follow-up. Although previous literature reported that the implant complications of PFLP were high, particularly in elderly women with fractured

proximal femurs[18], four patients had obtained fracture union successfully in our study, early ambulation and avoiding full weight-bearing exercise may be helpful for recovery.

Contrast Between Arthroplasty and Internal Fixation Revision

From the results we found that the operative time, intraoperative blood loss, and shortening of affected limb of arthroplasty was better than internal fixation revision. Correction of the varus deformity sometimes may be difficult for revision with internal fixation, arthroplasty procedure seems more rapid and beneficial to restore the limb length than internal fixation revision. At 3 months, 6 months postoperative and the last follow-up, there was no difference in the HHS between these two groups, hip joint function can be restored satisfactorily after arthroplasty and revision with internal fixation. This outcome is consistent with previous report that no clear functional difference between revision and arthroplasty of failure in intertrochanteric and subtrochanteric fractures[27]. Consideration the potential complications of arthroplasty, revision of internal fixation is still recommended for younger and femoral head intact patients.

Limitations of This Study

There were several limitations in this study that should be addressed. First, the level of evidence in this retrospective study was lower than the prospective randomized control study. Second, the number of cases was relatively small and the time of follow-up was short, so we need a large-sample, long-term follow-up clinical trial to confirm the surgical treatment methods and clinical effect in the future. Third, there were some differences in ages, bone conditions between the arthroplasty group and the internal fixation revision group, so sample selection bias objectively exists when comparing some relevant indicators.

Conclusion

For internal fixation failure of intertrochanteric and subtrochanteric fractures, young patients can accept revision with PFLP or extension of intramedullary nails to restore normal anatomical structure, correct varus deformity and autograft. Correction of varus deformity and restoration of femoral neck-shaftangle were essential for obtaining successful results. Elderly patients and patients with damaged femoral heads can be treated with arthroplasty to restore walking function, we should protect abductor function and avoid intraoperative shaft femoral fracture in the surgery procedure.

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