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Case Report

Application of the reversed LISS-DF technique in an elderly patient to salvage infection-related failure of trochanteric fracture fixation

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ABSTRACT

Failure of cephalomedullary fixation in geriatric trochanteric fractures is a potential complication. Attempts have been made to optimize the implant fixation (e. g. cement augmentation) and several factors (e. g. malreduction, tip apex distance) have been identified as risk factors for failure. Nevertheless, if intramedullary fixation fails, it is often associated with bone defects in mostly preexisting poor bone-stock. Accordingly, conversion to total hip arthroplasty (THA) is recommended by some authors as the only valid treatment option. However, in specific situations (e. g. implant associated infection) conversion to THA might be less reasonable than an attempt to re-osteosynthesis. This article reports on the successful use of a reversed contralateral LISS-DF (LISS for the distal femur, DePuy Synthes, Zuchwil, Switzerland) application after failed cephalomedullary fixation and failed re-osteosynthesis using a blade plate in a trochanteric fracture in an elderly patient with additional implant associated infection.

Introduction

Due to the increasing life-expectancy and average age of the population the incidence of hip fractures (e. g. trochanteric) in the elderly is still increasing [1]. Frequently, these fractures in this age group result from the combination of osteoporotic bone and a simple fall [2]. The preferred implant to treat these fractures are cephalomedullary nails (CMN) [3]. These implants offer an equal load distribution via the intramedullary fixation in comparison to eccentric load distribution of plate fixations and hence facilitate fracture healing (e. g. preservation of fracture hematoma, preservation of blood supply and soft tissue in the fracture zone) [4]. In osteoporotic bone, the stability of screw fixation decreases due to the shrinking bone mass and therefore cut-out of screws and resultant loss of fracture reduction and implant migration are noted and feared modes of failure in osteoporotic bone [5]. Several factors (e. g. varus malalignment, tip apex distance) have been reported to be risk factors for failure. If intramedullary fixation fails, it leaves behind a complex situation to deal with due to the disturbed anatomy of the proximal femur and poor bone stock left for fracture fixation by other implants during re-osteosynthesis [6]. Various authors have claimed that the only valid option to salvage failed intramedullary fixation is total hip arthroplasty (THA). Nevertheless, some patients and local biological situations (e. g. implant associated infection) may not be suitable for conversion to THA, thus simple re-osteosynthesis might be an alternative. Since alternatives to arthroplasty are

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occasionally warranted, we are therefore reporting on the successful use of LISS-DF (LISS for the distal femur, DePuy Synthes, Zuchwil, Switzerland) in reversed contralateral application [7] after failed CMN fixation and failed re-osteosynthesis using a blade plate with concomitant infection.

Case presentation

We present the case of an 82-year old female patient initially treated in another hospital presenting with an intertrochanteric femoral fracture with subtrochanteric extension after a stumble fall at home (Fig. 1). Initial treatment was performed using a CMN (Fig. 1). Postoperatively, a varus malposition of the fracture was apparent and due to persistent wound drainage 18-days after the initial treatment a revision was performed. Removal of the osteosynthesis, debridement, microbiological sampling and re-osteosynthesis using a blade plate was performed (Fig. 1). Within one week after the revision operation a failure of the osteosynthesis with varus dislocation of the fracture was apparent and the patient was transferred to our department (Fig. 2). Albeit noted soft-tissue damage previous microbiological sampling was negative (under antibiotics). The blade of the blade plate did not damage the hip joint as in CT scans no cut-out was noted. Accordingly, re-revision with removal of the osteosynthesis, debridement, microbiological sampling, correction of the varus dislocation and re-osteosynthesis using a pre-bended blade plate was performed by the senior author (Fig. 3). The initial postoperative period was inconspicuous for any infection, microbiological samples were negative and the patient was transferred to a nursing home. Four weeks later, the patient was readmitted due to fever and wound drainage since three days. Emergent treatment involved debridement and microbiological sampling. A delayed onset implant associated infection with *Pseudomonas aeruginosa* was diagnosed and one-stage revision was planned [8,9].

The patient was placed in lateral decubitus position and a subvastus approach was performed. Complete removal of the hardware, debridement, and microbiological sampling was carried out, followed by subsequent fracture reduction and stabilization with a LISS-DF (LISS for the distal femur, DePuy Synthes, Zuchwil, Switzerland) in reversed contralateral application by the senior author [7]. The greater trochanter fragment with the attached gluteus medius tendon was preliminarily fixed using reduction clamps and K-wires. The plate was first fixed proximally with locking screws and then distally with eccentrically placed screws for valgisation and compression of the fracture (Fig. 3). The postoperative regime included wheel-chair mobilization for eight weeks and limited flexion of 70°. Full weight-bearing was established three months after the revision operation. The antibiotic regime consisted of four weeks intravenous Cefepime and additional eight weeks oral Ciprofloxacin therapy. At 1-year follow-up the patient displayed no pain. Her pre-injury activity level as measured with the Parker Mobility Score (PMS) [10] was nine out of nine points; she had regained a PMS level of 7 points at one year follow-up. Conventional x-rays showed a healed fracture, with no implant migration, no osteoarthritis and the

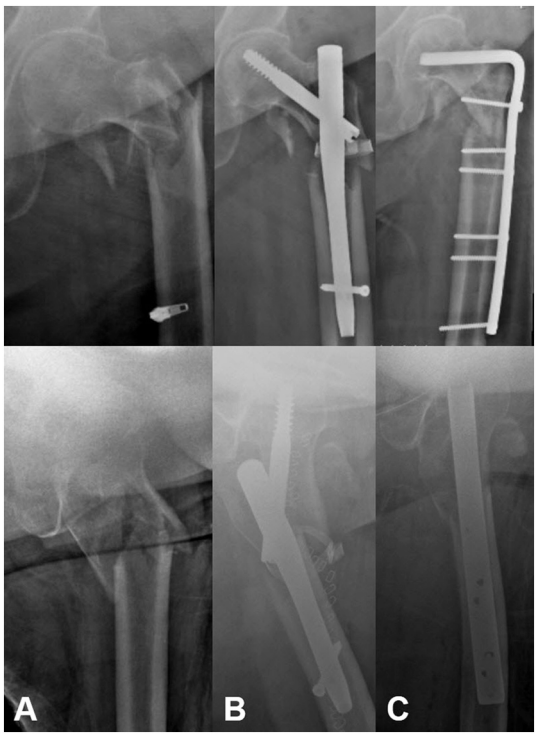

Fig. 1. Radiographs of the left hip joint in anteroposterior (upper row) and axial (lower row) views presenting (A) a trochanteric fracture before fixation, (B) after fixation using a CMN and a cerclage in malreduction and (C) after revision surgery using a blade plate within three weeks after index operation with the proximal femur still in varus malposition.

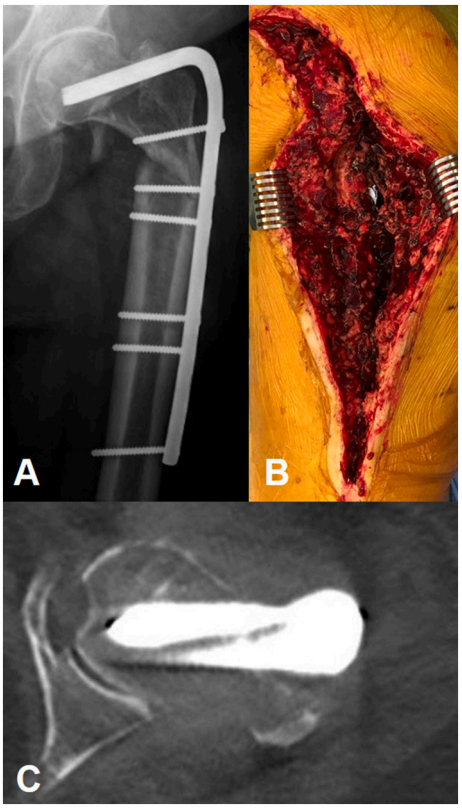

Fig. 2. Deformation of the plate blade with increased femoral varus misplacement was noted on (A) radiographs of the left hip joint in the anteroposterior view four days after last revision. Due to distinct soft-tissue damage as shown in (B) intraoperative photograph and no cut-out of the blade without any intraarticular damage as observed in (C) axial CT scans a revision using the reversed LISS-DF technique was performed.

infection was cured (Fig. 3).

Discussion

As has been shown in previous clinical and biomechanical studies, the implant of choice for trochanteric fractures are CMNs [3]. However, in cases of subtrochanteric fracture extension the choice of implant is critical due to the local anatomic and biomechanical features that can make fractures in these regions difficult to treat [11]. A recent meta-analysis showed advantages of intramedullary nailing over extramedullary fixation in terms of fracture fixation complications, which is why their use in elderly patients is particularly recommended [12]. However, if intramedullary fixation fails, it leaves behind a situation to deal with due to the disturbed anatomy of the proximal femur and poor bone stock left for fracture fixation by other implants during re-osteosynthesis [6].

Failure to achieve precise fracture reduction and faulty insertion of CMN is often responsible for failure and non-union [6,13]. Several studies have shown that varus reduction is associated with a higher risk of failure (e. g. cut-out) [14–16]. Some authors emphasized that no implant, however strong it may be, can sustain the undue forces on the implant in the setting of poor reduction and non-union [14,17]. In the presented case, an insufficient reduction with varus malalignment was apparent after the initial treatment.

Alternatively, arthroplasty has been proposed by some authors as an alternative treatment option to internal fixation for unstable intertrochanteric fractures in elderly patients [18–21]. In a randomized controlled trial comparing proximal femoral nail with a long-stem cementless calcar-replacement prosthesis the authors found shorter operative time, less blood loss, fewer units of blood transfusion, lower hospital costs and a lower mortality rate for patients treated with proximal femoral nail [19]. No difference in the functional outcome, time to weight bear, length of hospital stay and general complication was found. They stated that in elderly patients a proximal femoral nail provides superior clinical outcomes, but no advantage with regard to functional outcomes, if compared with a long-stem cementless calcar-replacement arthroplasty [19].

Most of the authors recommended performing arthroplasty only in selected cases with hip osteoarthritis, avascular necrosis of the femoral head, inflammatory arthritis, neglected fractures and failed internal fixation. Nevertheless, surgeons should be aware of the increased complexity of doing arthroplasty in these frail patients because of the increased blood loss, poor bone quality, absence of the calcar, a deficient lateral wall, the need for abductor repair and higher incidence of dislocation [17]. In the case presented, initial fracture fixation was carried out with internal fixation using a CMN as is generally recommended. During revision surgery, re-osteosynthesis was chosen over arthroplasty due to the apparent infection and consequently easier treatment if revision would

Fig. 3. Radiographs of the left hip joint in anteroposterior (upper row) and axial (lower row) views presenting (A) the 2nd revision using a prebent blade plate and 3.5 mm screws, (B) after 3rd revision for treatment of a delayed onset of an implant associated infection with *Pseudomonas aeruginosa* using the reversed LISS-DF technique and (C) the radiological follow-up at one year with the fracture healed and the infection cured.

have to be carried out.

It was claimed by previous studies that the only valid option to salvage failure of PFN-A helical blades is the conversion to arthroplasty [22]. However, conversion to arthroplasty after failed fixation of a trochanteric femoral fracture is technically more demanding than failed femoral neck fracture and is associated with longer operation times, higher blood loss, need for a revision femoral component due to the needed distal fixation, higher risk of periprosthetic fracture and dislocation [23,24].

Promising results were shown in biomechanical tests evaluating treatment with the reversed LISS-DF technique for unstable trochanteric fractures in the elderly or as a salvage procedure for such fractures [25,26]. Several clinical studies have recommended the use of the LISS-DF in selected cases. Acklin et al. presented a series of 14 cases and recommended the use as possible alternative in young patients with multifragmentary proximal femoral fractures [7]. Ma et al. recommend the use as alternative in unstable proximal femoral fractures in which nailing is unreasonable as a treatment option in a series of 20 cases [27]. Some unstable proximal femoral fractures are difficult to nail, including subtrochanteric fractures, patients with narrow femoral canals and short skeletons, adolescents with open physes and patients with severely deformed or bowed femurs [28]. In these situations, extramedullary fixation with plates and screw is recommended [27]. Han et al. reported the results of 41 proximal femoral fractures either treated with PFN-A or reversed LISS-DF and concluded that the reversed LISS-DF system was more effective in avoiding coxa vara and may be indicated for patients with severe osteoporosis [29]. Hanke et al. reported the use in a patient with osteogenesis imperfecta with severe femoral bowing and poor bone quality [30]. Vaishya et al. reported on a series of 12 cases with non-union and failed PFN-A fixation of proximal femoral fractures including subtrochanteric fractures [6]. They concluded that the reversed LISS-DF is a safe implant of choice for the management of nonunion associated with failed PFN-A. It offers several anatomical, biomechanical and clinical advantages in these complex situations [6].

A limitation of the current report is the short follow-up of only one year after revision surgery. Nevertheless, this follow-up period of only one year seems appropriate, since larger follow-up studies presenting the outcomes after fixation of trochanteric femoral fractures did not present longer follow-up periods and the fracture has healed [31–33]. No osteoarthritis progression was apparent at one year follow-up. This may be due to the short follow-up, however, no association of osteoarthritis progression after trochanteric fractures had been reported by previous studies [34].

In conclusion, the LISS-DF system used in reversed application might be a valuable option to salvage failed fixations of trochanteric

fractures in elderly patients complicated by implant associated infections when conversion to total hip arthroplasty might be less reasonable.

Data availability

All data supporting the conclusion has been presented in that case report.

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Consent

Informed consent by the patient has been obtained.

Declaration of competing interest

No author has to declare any conflicts of Interest.

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