Case Report

Cement detachment from the cephalic blade in an intertrochanteric fracture fixation – A case report

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Introduction

Hip fractures are common in the elderly population, with an estimated 18% of women and 6% of men suffering from such fractures globally [1]. It constitutes an important public health problem as there is a trend towards an aging population nowadays, and it is estimated that the disease burden of hip fractures will reach up to 4.5 million hips by the year 2050 [2]. Intertrochanteric (IT) fractures are among the two most common types of hip fractures, with a predilection for the more elderly population compared to femoral neck fractures.

The treatment of intertrochanteric (IT) fractures can be divided into non-surgical and surgical. Typically, non-surgical treatment is not recommended, and reserved for patients with high operative risk as well as poor pre-morbid function. Surgical treatment is recommended as fixation allows patients better mobilization, reduced in-hospital stay and reduced mortality [3].

Surgical fixation of IT fractures can be performed via extramedullary fixation or intramedullary fixation. Extramedullary fixation is usually performed via plate and screw fixation, with a dynamic hip screw construct. Intramedullary fixation is usually performed via cephalomedullary nail fixation, which consists of an intramedullary nail in the shaft of the femur as well as a cephalic blade into the femoral head.

A common mechanical complication of cephalomedullary nail fixation is implant migration, more specifically cephalic device cut out or cut through [4]. One of the methods to address the problem of cephalic blade migration is cement augmentation of the femoral head. This is performed via specialised fenestrated cephalic devices (blade/screw) and standard bone cement, polymethylmethacrylate (PMMA). Biomechanical studies have shown that cement augmentation around the cephalic blade yields superior rotational stability and increased pull out resistance of cephalic blades compared to non-augmented implants [5]. This benefit was higher in patients with lower bone mineral density (BMD), suggesting that osteoporosis and poor bone quality was a significant risk factor in terms of cephalic device migration.

There are many different cephalomedullary nailing systems in the market, but the one most commonly used in our institution is the system developed by DePuy Synthes: TFN-ADVANCED™ Proximal Femoral Nailing System (TFNA) together with their proprietary cement augmentation system Traumacem V+ (DePuy Synthes, West Chester, PA, USA).

In this report, we describe the first case of cement detachment from the cephalic blade from the TFNA following fixation of an IT fracture in an elderly lady.

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Case report

Our patient is a 79-year-old lady who has a history of hypertension, hyperlipidemia, type 2 diabetes mellitus (DM), hypothyroidism and dementia. She was pre-morbidly independent in her activities of daily living and was community ambulant without the need for walking aids.

She presented with an unwitnessed fall at home. She was found to be seated on the floor of her bedroom by her domestic helper. According to the patient, she had been trying to get out of bed when she lost her balance and fell backwards, landing on her left buttock. There were no other injuries reported. She was unable to ambulate or bear weight on her left leg thereafter. On examination, she was noted to have bruising around her left hip and tenderness on palpation. Distal neurovascular status was preserved and there were no other injuries noted general survey. Radiographs showed a 2-part displaced left intertrochanteric fracture (Fig. 1).

She was planned for surgical fixation of her left intertrochanteric fracture. However, the surgery was delayed for 7 days due to the need for pre-operative optimization of her medical co-morbidities. Her blood investigations showed poorly-controlled DM (HbA1c of 12.1% (optimal: 6.5–7.0%) and hypothyroidism with free thyroxine-4 levels of 5.5 μg/dl (normal: 4.6–12 μg/dl) and TSH levels of 60 mU/L (normal: 0.4–4.0 mU/L). She eventually underwent surgical fixation of her left IT fracture with a cement-augmented cephalomedullary nail (TFNA with Traumacem V+). Radiographic measurements post-operatively showed good reduction and alignment. The tip-apex distance (TAD) [6,7] was 23.6 mm, calcar tip-apex distance (CalTAD) [8] was 21.8 mm (Fig. 2), Parker’s ratio [9] was 41.0% (anteroposterior (AP)) and 65.0% (lateral) (Fig. 3). Quality of reduction (according to Baumgartner method) was good – both displacement criteria and angular reduction criteria were met [10]. Her neck-shaft angle on the AP and lateral views were measured at 141.3 degrees and 16.5 degrees respectively (Fig. 4). She was started on ambulatory physiotherapy early in her post-operative recovery, and was allowed partial weightbearing as tolerated. The surgeon chose not to let the patient bear full weight in the immediate postoperative setting due to her severe osteoporosis. The rest of her inpatient stay was unremarkable and she was discharged well.

She was seen in our specialist outpatient clinic for a follow-up visit one month following surgery. There was mild pain in her left hip, but she reported that it was improving since the surgery. She had been well and had been ambulating slowly around the home with the assistance of a walking aid. She denied any falls or trauma to the left hip since her discharge. However, it was noted on radiographs that there was varus collapse of the fracture (neck-shaft angle 127 degrees (AP) and 46 degrees (lateral)) with cephalic blade migration into the superior half of the femoral head. There was also a sliver of cement which remained in the original position, suggesting detachment of the cement mantle from the cephalic blade (Fig. 5). Based on these radiographic findings, the decision was made by the surgeon to keep her non-weightbearing on the affected leg in order to allow fracture healing. The patient and her family were counselled on the possible need for revision surgery in the event that the fracture does not heal and the cephalic blade cuts-out of the femoral head. Fortunately, at the subsequent two follow-up visits, there was clinical and radiographic evidence of fracture healing. At four months follow up, there was no pain in the left hip and minimal further varus collapse and she was allowed to return to weightbearing as tolerated on her affected hip. At 8 months follow up, there remained no pain in her left hip and no further collapse of the fracture (Fig. 6).

Fig. 1. Initial radiographs of left intertrochanteric fracture.
Fig. 2. Tip-apex distance measurements.

Fig. 3. Parker’s ratio measurements.

Fig. 4. Post-operative radiographs showing the alignment of the hip post-fixation.
Discussion

This case is noteworthy as it is the first reported cement detachment from the cephalic blade of the cephalomedullary device following treatment of an IT fracture.

Cephalic blade cut-out is the most commonly reported mechanical complication of cephalomedullary nail fixation. In attempts to reduce this complication rate, many clinical and biomechanical studies have tried to identify factors which affect implant cut-out risk. These factors include modifiable factors (quality of reduction [4], correct positioning of the cephalic device [11,12] and type of cephalic device used [13,14]) and non-modifiable factors (fracture configuration/stability [15] and BMD [16]).

Our patient had good reduction (as graded by the Baumgartener method) and correct positioning of cephalic device (TAD and

Fig. 5. Radiographs at 1 month post-operatively, showing varus collapse and implant migration, as well as a fractured cement mantle.

Fig. 6. Radiographs at 8 months post-operatively.
CalTAD were within 25 mm; Parker’s ratio (AP) was >45% and her initial fracture configuration was a 2-part fracture with minimal comminution. Her main risk factor for failure was that she had significant osteoporosis (BMD T-score = −3.3). Due to the fact that she had significant osteoporosis (which is a non-modifiable risk factor for cephalic blade cut-out), we opted to perform cement augmentation to reduce the chance of cut-out.

In analysing the cause of failure in this patient, we have to consider the various factors which have been proposed to result in higher cut-out risk. Turgut [4] described that varus reduction was the most important factor that predicted cut-out complication, followed by improper quadrant implantation of the cephalic device and the tip-apex distance. With regards to our patient:

(a) The post-operative colo-diaphyseal angle (CDA) in this patient measured 140° (CDA >130° has a higher risk of implant cut-out [17]). A normal neck shaft angle has been proposed to be between 127° and 130.5° [18]. It is possible that valgus reduction may impart excessive stress on fixation stability and hence potential failure at the cement-implant interface. However, this remains a postulation, as there are few reports in the literature on correlation between increased neck-shaft angle and implant failure.

(b) The cephalic device was implanted in the inferior-center and anterior-center quadrants on AP and lateral views respectively.

(c) Reduction of the fracture was graded as “proper”, while all other locations are improper. In our case, the cephalic device seems to lie in the anterior-center quadrant (with a Parker ratio of 65%) suggesting suboptimal anterior-posterior placement. This may have been a contributing factor to instability.

(d) The tip-apex distance fell within the 25 mm range as described by Baumgartener (though it measured 23.8 which was nearing the upper end of the range).

(e) There was some slight bone loss and thus malreduction/apposition of the fracture over the medial calcar post-reduction.

Most of the parameters used to described reduction and implant placement seem to agree that there was adequate reduction in this case, though there was slight medial calcar bone loss. Therefore, we feel that the main contributor to her current implant failure was osteoporosis, which was a non-modifiable factor at the time of her surgery. She had significant osteoporosis (T-score = −3.3) thus we opted to enhance our fixation with cement augmentation to reduce the risk of cut-out.

In the current literature, there have been no reports of cement-augmented cephalic blade cut-outs or cement detachments. A study by Yee et al. in 2020 reported a lower rate of fixation failure in the cement-augmented group vs the uncemented group (2.1% vs 13.8%). There were no reports of cut-outs in the cement-augmented group. The one reported failure in the cement-augmented group was due to implant breakage through the aperture for the cephalic blade, while the four reported failures in the uncemented group were due to cephalic blade migration (3 cases of cut-outs and 1 case of cut-through) [20].

The current literature suggests that cement augmentation has reduced the rates of cephalic blade cut-out, though the evidence is not strong yet. Biomechanical and clinical studies have supported the use of augmented cephalic blades in the treatment of IT fractures [5,20]. In our case, we hypothesize that a possible reason for cephalic blade migration despite cement augmentation is toggling of the cephalic blade within the femoral head. This toggling is likely due to 2 main factors – (1) the stability of fixation and (2) the physiological forces acting on the hip during normal range of motion. A majority of cut-outs in uncemented cephalic blades are in the anterior-superior direction, and we feel that this predilection for the anterior-superior direction is due to the forces acting on the hip joint during gait/ambulation. This can be thought of with the help of an orange juicer analogy, where the orange represents the head of the femur and the blade implant represents the juicer. The action of loading the hip can cause coring out of the orange flesh in a similar way to how the blade can core out the cancellous bone in the femoral head. Therefore, with this possible mechanism in mind, we should aim to direct the majority of the cement augmentation towards the anterior-superior quadrant of the femoral head. In the current cement augmentation technique, there has been no emphasis on directing the cement towards any particular direction. Further studies could look towards investigating whether there is a direction in which cephalic blades usually cut-out and whether directing cement augmentation towards this direction helps to reinforce the bone there to reduce the rate of cut-out. Another important learning point from this case is that cut-outs, if identified early, can be salvaged with non-weightbearing to reduce the displacement of the fracture and allow fracture healing before progressing to weightbearing.

Declaration of competing interest

There is no conflict of interests to be declared.

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