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Technical note

Salvage reconstruction of hip ligaments using absorbable material to treat recurrent instability of revision THA without abductor mechanism.

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Abstract

Dual-mobility and constrained cups can stabilize most recurrent dislocations of total hip arthroplasty (THA), but may fail in case of hip abductor mechanism loss. For such complex situations, we developed an original artificial iliofemoral and ischiofemoral ligament reconstruction technique using a polyglactin 910 mesh (Vicryl™) associated to repositioning of a Lefèvre constrained liner adapted to hip range of motion to prevent cam effects. The technique was implemented in 2 patients showing recurrent dislocation after THA, associating total femur replacement and cemented constrained liner in a metal reinforcement ring. In 1 of the 2 cases, the abductor mechanism had been entirely sacrificed. This simple and accessible salvage technique prevented recurrence of dislocation at 12 months' follow-up in these complex cases, previously subject to several episodes per year.

Key-words: Total hip arthroplasty, recurrent dislocation, artificial ligament, constrained liner, ligament reconstruction, polyglactin (Vicryl™).

1. Introduction

Stabilization of recurrent dislocation of total hip arthroplasty (THA) is generally achieved using a dual mobility (DM) cup [1-3]. Constrained implants (CI) such as the Lefèvre liner (Lépine, Genay, France) provide immediate extra stabilization, whereas DM cups can fail, notably in revision, tumoral or septic surgery [4-7] and especially when all hip stabilizers (muscle, capsule, ligaments) have been resected [6], as is not rare in case of total femur replacement [8]. In such cases, stabilization techniques for multi-recurrent dislocation are not codified, with a risk of disarticulation or abandonment of treatment [8]. We managed 2 such cases, with failure of stabilization despite use of CI on total femur replacement, leading us to develop a novel artificial reconstruction technique for the anterior and posterior hip rotation restraint mechanisms (comparable to iliofemoral and ischiofemoral ligament reconstruction) associated to a Lefèvre constrained liner reoriented according to individual range of motion so as to prevent cam effects.

2. Technique

A posterolateral approach was used, with the patient in lateral decubitus. The technique requires a stable screwed acetabular reinforcement ring; we removed the cup and cement from the metal reinforcement, which was left in place as it was always well fixed. A polyglactin 910 (Vicryl™) mesh (Ethicon, Johnson & Johnson, Somerville, NJ, USA) was folded in six and the excess was cut off with scissors so as to obtain a width of 20 mm (Figure 1A), then it was screwed into the middle of the reinforcement ring, forming two bands (Figure 1B). A trial insert optimally reproducing the shape of the Lefèvre liner was temporarily fixed with bone wax, to enable the hip to be reduced and tested so as to optimize the positioning of the final constrained liner and predict cam effects and adaptation to the particular femoral component that was left in place [4]. The definitive CI was then cemented

into the reinforcement ring, stretching the mesh bands against the cup to avoid creasing in the cement mantle (Figure 1C). When the cement had polymerized, the mesh bands were fixed onto the prosthetic trochanter by non-absorbable suture (Mersuture™, Ethicon Johnson & Johnson, Somerville, NJ – USA). Three sutures were tied to fix the bands on the anterior and posterior sides of the implant through dedicated tunnels in the total femur implant (Figure 2). The ends of the 2 bands were then tied together and sutured with 3 Mersuture™ X stitches onto the lateral side of the implant (patient 1) or the native greater trochanter (patient 2). The course of the bands thus reproduced the course of the iliofemoral and ischiofemoral ligaments. Tensioning on the anterior and posterior sides was adjusted so as to prevent cam effects between neck and cup: the posterior band was stretched and fixed with the femur in 90° flexion and medial rotation (Figure 3A), and the anterior band with the femur in neutral extension and lateral rotation (Figure 3B) (film 1).

Postoperatively, 6 weeks' immobilization was prescribed in an ipsilateral articulated hip orthosis allowing 0 to 60° range of motion in flexion; the sitting position was allowed. At 6 weeks, full weight-bearing was allowed with rehabilitation focused on muscle reinforcement, followed by resumption of walking with then without aids.

3. Results

In both cases, the total femur implant with tibial shaft fixation (Implantcast, Buxtehude, Germany) articulated with a Lefèvre constrained liner (Lépine) cemented into a Müller ring (Zimmer-Biomet, Winterthur, Switzerland) (Table 1). Indications in both cases were for non-union of iterative fracture between hip and knee implants, both showing recurrent dislocation.

Case 1: Ms D. (72 years, body-mass index (BMI) 37) had undergone hip arthroplasty with total femur and conserved greater trochanter, with 10 dislocations despite use of a DM cup then a Lefèvre liner, both cemented in a Müller ring. (Figure 4A). Finally, she contracted

methicillin-resistant *Staphylococcus epidermidis* infection requiring 1-stage exchange of the total femur and acetabular components (cup and ring). The sequestered greater trochanter, capsule and ligament reinforcements were resected. The prosthesis dislocated again 5 times in 1 year (Figure 4A), and ligament reconstruction was performed (Figure 4B).

Case 2: Ms B. (61 years; BMI 32) had 3 dislocations after implantation of a total femur articulated with CI with conserved greater trochanter and upper part of the lateral cortex fixed with cerclage wiring to the implant (Figure 5A). In the first dislocation, the cup retention ring became detached and the dislocation was irreducible without open reduction and associated ligament reconstruction. She had no history of infection (Figure 5B).

In both cases, clinical assessment at 12 months found no repeat dislocation, despite history of several episodes per year. Table 1 shows functional results.

4. Discussion

Treatment for recurrent THA dislocation is not well defined after resection of the proximal femur and/or hip stabilizers [5-7,11]. This is especially true of total femur prostheses, for which the main complication is dislocation, with rates as high as 6.9% [8]. DM cups have proved effective in preventing dislocation in primary THA revision [1,2,12], notably in tumor surgery involving soft-tissue resection [6]. North American tripolar cups are effective, but with risk of loosening and mechanical complications due to their high constraint and complexity [13]. Lefèvre CIs are a possible solution in case of DM failure, without the mechanical complications of the North American models, being less constrained [4,5].

There exist techniques of abductor mechanism reconstruction using the quadriceps [14] or gluteus maximus plus tensor fasciae latae [15], but they require intact transplants that

are sacrificed and are unsuitable in case of trochanteric resection. Allograft reconstruction [16], is expensive, and unsuited to septic contexts.

The literature on artificial capsule reinforcement is sparse and mainly concerns tumoral reconstruction, notably in the shoulder [17]. To our knowledge, only 2 articles reported capsule reinforcement in chronic hip instability: 1 isolated iliofemoral ligament reconstruction [18], and 1 isolated ischiofemoral ligament reconstruction [19].

Polyglactin 910 (Vicryl™) resorbs by hydrolysis after 56-70 days, and at 12 months most of the constraint can be expected to have transferred to fibrous scar tissue reproducing the mesh bands and thus the joint ligaments. Longer follow-up should confirm that interposition of the 2-cm absorbable band between reinforcement ring and cup does not jeopardize fixation. The alternative, consisting in fixing two separate bands in the bone or in the ring, seems unduly complex. In revision surgery, where bone stock is often diminished, this solution incurs problems of immediate stability in the bands, weakening due to the bone tunnels, and difficulty in fixing new hardware with risk of impingement.

The present technique acts simultaneously on 2 parameters: cup repositioning, and ligament reconstruction; respective efficacy, and notably the isolated effect of cup repositioning, is thus impossible to assess. Even so, radiologic analysis (Table 1) showed satisfactory preoperative implant positioning. Clavé et al. [4] recommend orienting the Lefèvre liner in slight anteversion and 50° inclination. The technique also requires cup exchange and, in all cases, repositioning taking account of the existing femoral implant which may not be in optimal anteversion. This is why, to stabilize these revision implants, we prefer to orient the cup according to joint mobility and so as to limit cam effects, rather than using absolute inclination and anteversion values.

This technique prevented recurrence, admittedly only at 1 year's follow-up, but in patients who had been subject to several episodes per year. However, longer follow-up is needed to determine whether increased constraint jeopardizes acetabular fixation.

5. Conclusion

This innovative technique offers a fairly simple and accessible salvage solution for multi-recurrent dislocation in the absence of the abductor system, especially for total femur implants, but cannot resolve implant malpositioning. Results were satisfactory at 1 year, but need longer-term confirmation in a larger sample, although this extreme situation is, fortunately, fairly rare.

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Figure legends

Figure 1: Preparation of the polyglactin (Vicryl™) mesh, with screw-hole (1A). Positioning first screw for fixing to reinforcement ring (1B). Cementing Lefèvre constrained liner and tensioning of mesh bands (1C).

Figure 2: Preparation of Mersuture™ sutures through tunnels in total femur implant for mesh band fixation.

Figure 3: Fixation of stretched posterior band in 90° flexion and medial rotation to prevent anterior cam effect (3A). Fixation of anterior band in neutral extension and lateral rotation to prevent posterior cam effect (3B). Note 2 bands, knotted and sutured by Mersuture™ to the lateral side of the total femur implant.

Figure 4: Preoperative dislocation despite Lefèvre CI (4A). The whole femoral bone, including the greater trochanter, was resected for 1-stage exchange due to methicillin-resistant *Staphylococcus epidermidis* infection. Radiograph of technique at 12 months (4B).

Figure 5: Preoperative dislocation despite Lefèvre CI (5A). Conserved greater trochanter and lateral cortex fixed by cerclage wiring to the total femur implant. Radiograph of technique at 12 months (5B).

Film 1: Intraoperative dynamic hip test after anterior and posterior artificial ligament reconstruction.

Table 1: patient data

Case:	#1: Ms D.		#2: Ms B.	
Gender	Female		Female	
Age (years)	72		61	
BMI (kg/m²)	37		32	
Number of ipsilateral hip procedures	8		5	
Infection	Yes: MRSE, cured		No	
Number of dislocations since last surgery (total)	5 (18)		3, incl. 1 irreducible (8)	
Capsule-ligament system	Absent		Absent	
Abductor system	Absent		Present	
<u>Implants:</u>	<u>Preop</u>	<u>Postop M12</u>	<u>Preop</u>	<u>Postop M12</u>
Femoral	Total femur	Total femur	Total femur	Total femur
Head size (mm)	28	28	28	28
Acetabular	Müller ring + Lefèvre CI	Müller ring + Lefèvre CI	Müller ring + Lefèvre CI	Müller ring + Lefèvre CI
Frontal cup inclination (°) / bi-U line	57	45	33	43
Cup anteversion (°) according to Ackland et al. [9]	31	15	29	22
Limb-length discrepancy (cm)	-4	-3.5	-1	-1
Oxford score / 60 [10]	38	36	29	28
Range of motion (°)				
Flexion/extension	100/10	100/10	110/10	110/10
Abduction/adduction	20/10	20/20	20/10	20/10
Internal/external rotation	50/20	40/20	30/20	30/20

Preop: preoperative; post-op: postoperative; MRSE: methicillin-resistant *Staphylococcus epidermidis*; M: months; BMI: body-mass index

Figure 1 :

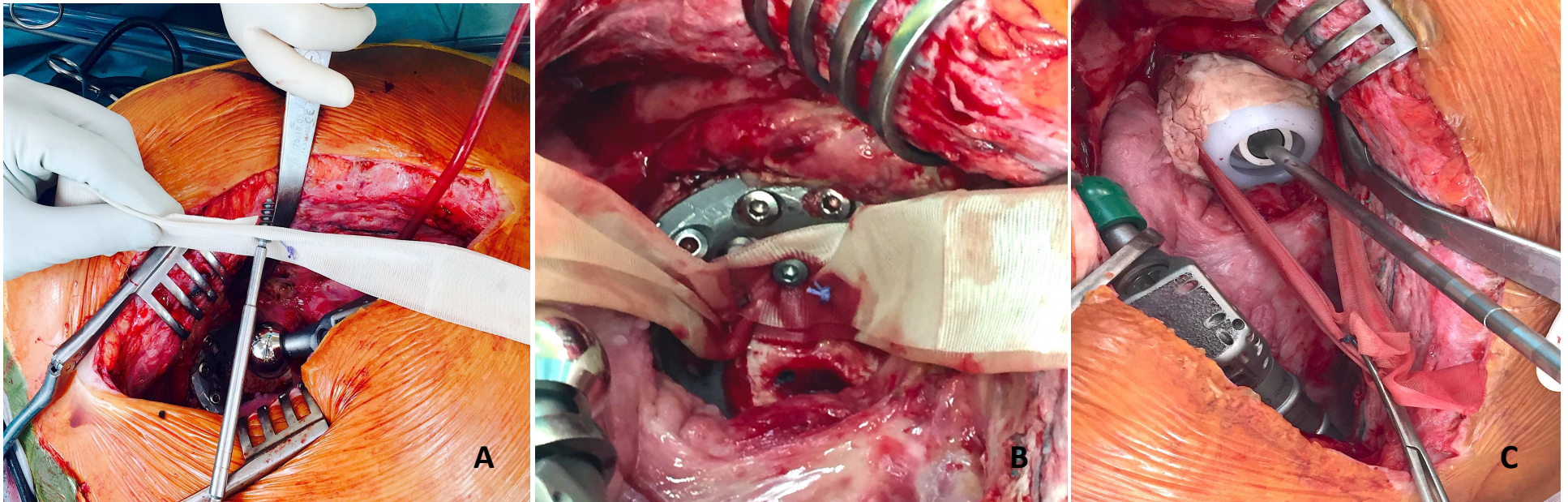


Figure 2 :

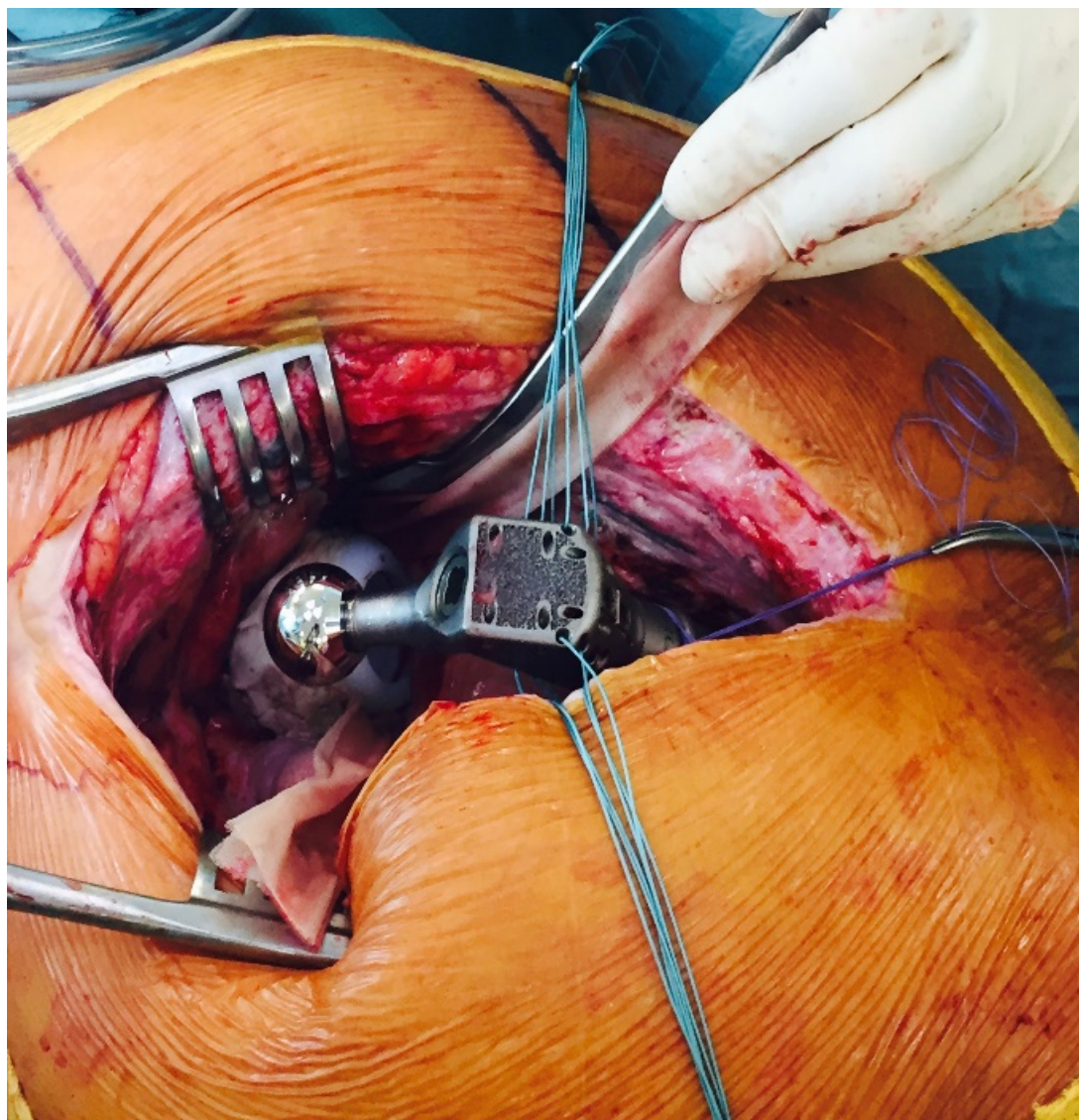


Figure 3 :

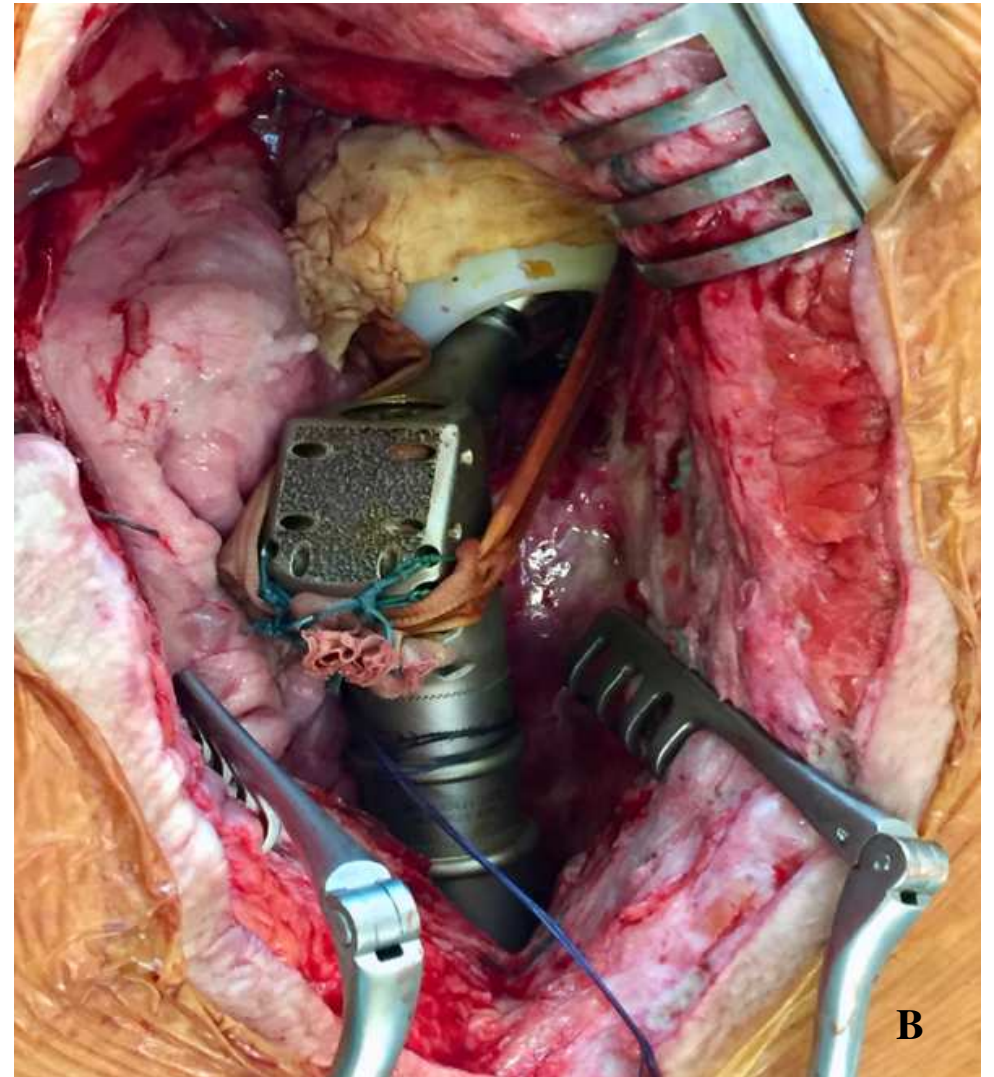
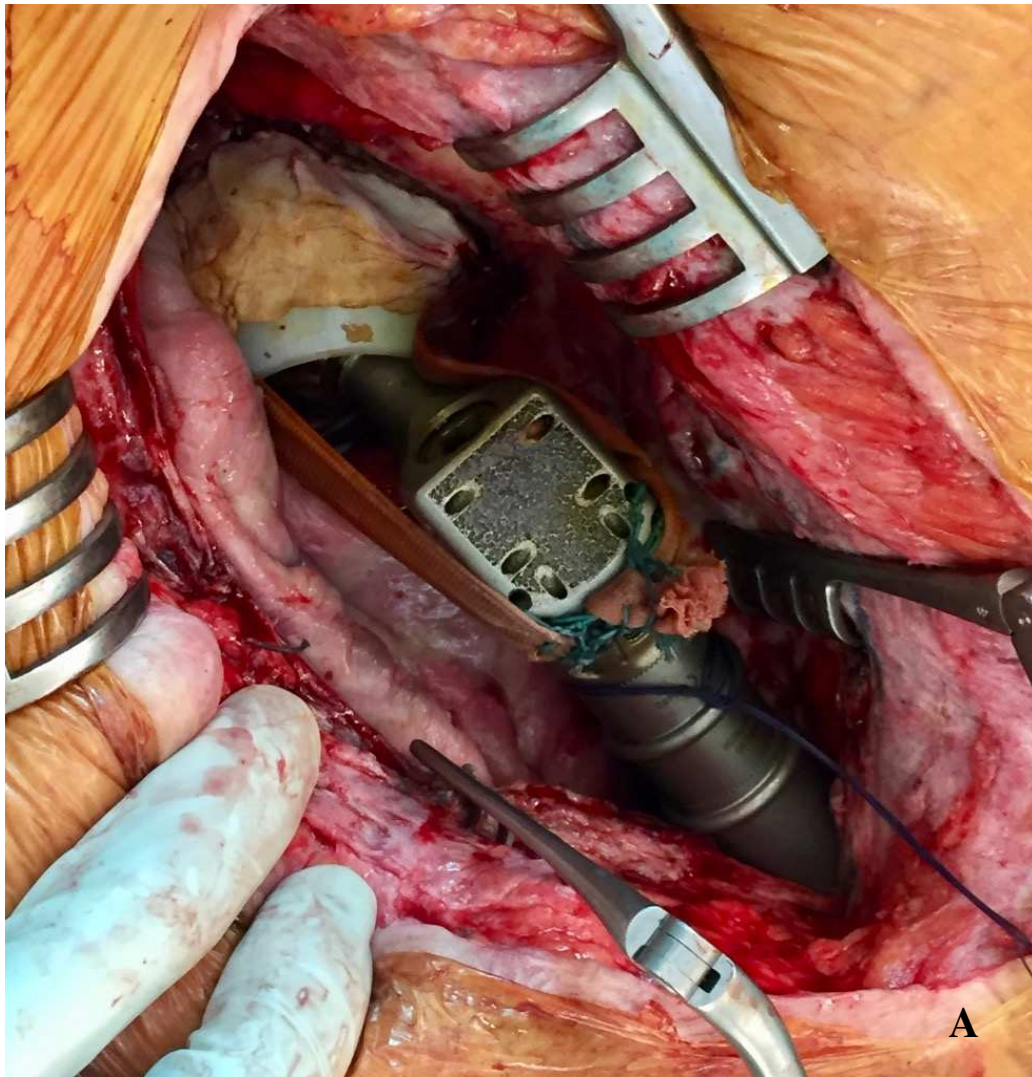


Figure 4 :

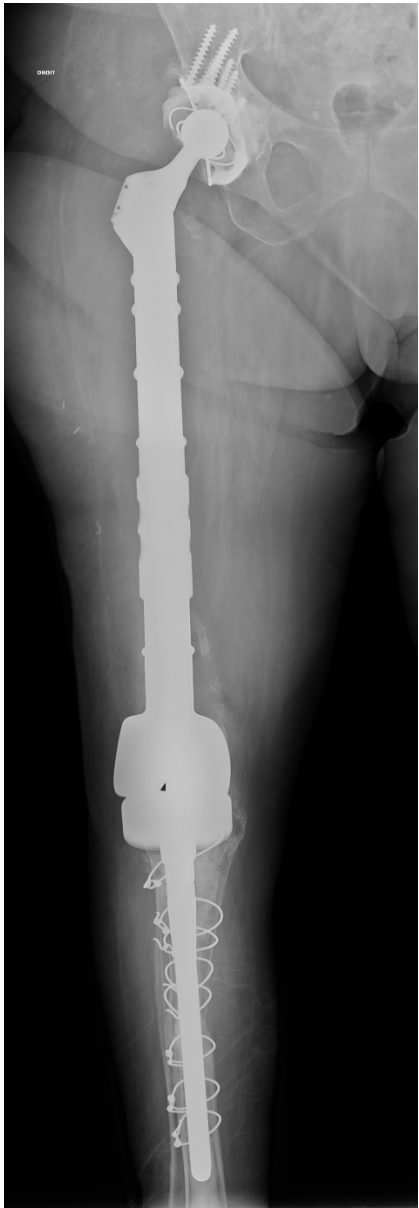


Figure 5 :

