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Review

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Direct anterior approach complications for total hip arthroplasty

Complicaciones del abordaje anterior directo en artroplastía total de cadera

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ABSTRACT. The direct anterior approach (DAA) for total hip arthroplasty has been popularized in the last decade as a minimally invasive approach used by many surgeons, including the authors, to preserve the integrity of muscle groups and their insertions and the dynamic hip stability resulting in less surgical trauma and faster recovery process with decreased postoperative pain. This surgical approach is not without a variety of complications and pitfalls. This review aims to identify any potential drawbacks and challenges associated with the DAA in THA and guide surgeons on minimizing and avoiding them.

Keywords: total hip arthroplasty, direct anterior approach, minimally invasive, complications.

RESUMEN. El abordaje anterior directo (AAD) en artroplastía total de cadera se ha popularizado en la última década como un abordaje de mínima invasión utilizado por varios cirujanos, incluyendo a los autores, con la ventaja de preservar la integridad de los grupos musculares de la cadera y sus inserciones, así como la estabilidad dinámica de la articulación, resultando en menor trauma quirúrgico y una recuperación más rápida con menos dolor postoperatorio, a pesar de esto, el abordaje quirúrgico no está exento de complicaciones. El propósito de esta revisión es describir los riesgos y complicaciones potenciales relacionados al abordaje anterior directo en cirugía de artroplastía total de cadera y presentar una guía de cómo minimizarlas o evitarlas.

Palabras clave: artroplastía total de cadera, abordaje anterior directo, mínima invasión, complicaciones.

Introduction

Total hip arthroplasty (THA) is considered one of the world's most influential and most often performed procedures by orthopedic surgeons. Due to the muscle-sparing technique and the care of the anatomical structures, this approach offers several advantages. However, there are diverse complications associated with it, as well as a trend toward smaller incisions and less invasive procedures; the direct anterior approach (DAA) has gained popularity in the last decade,[1] and the number of surgeries performed through it is steadily increasing. Numerous studies have described the benefits and drawbacks of this surgical techniques, highlighting its potential risks compared to its benefits.[2]

While being a recently popularized minimal invasive approach used by many surgeons, including the authors, to preserve the integrity of muscle groups and their insertions, resulting in less surgical trauma in THA and facilitating a faster recovery process, the DAA is not without its own unique set of complications and pitfalls. This review

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intends to identify the potential drawbacks and challenges associated with the DAA in THA and guide surgeons on minimizing them.[3,4]

Material and method

The intraoperative and postoperative complications of patients who underwent THA with a DAA were thoroughly reviewed in the existing literature and at the authors' private practice. We provide current opinions on feasible preventative actions for these issues.

Direct anterior approach complications

Can be related to the surgical approach and the component positioning or the extremity manipulation when a special table is employed, the extended time in fluoroscopy usage, or the surgeon's learning curve. Complications can be divided into two groups: Minor and major complications[5,6] and are described in *Table 1*. Multiple reports have been published recently describing complication patterns regarding different surgical approaches. In most of them, the conclusion is that the lateral approach has the lowest periprosthetic fracture rate, and the anterior and posterior approaches have lesser muscle damage with a faster recovery. The anterior approach has the lowest dislocation rate among the others.[7]

Approach-related complications

The incision begins 2 cm distal and 3 cm lateral to the anterosuperior iliac spine and continues obliquely between 8 and 10 cm distal and slightly laterally, over half of the palpable muscle mass of the tensor fascia lata (TFL) *(Figure 1)*, the skin is at risk during surgery, this is the most encountered minor complication either by excessive traction of the automatic retractors or by the superficial introduction of the broaches. In overweight, elderly, and/or patients with great quadriceps muscles, the incision should be adjusted to the surgeon's requirements initially to avoid injuring the dermis. An obese patient who has an overhanging fat apron will have poorer skin in the proximal part of the wound,

Table 1: Minor and major complications.

Minor complications	Mayor complications
Superficial infection	Periprosthetic infection
Wound abrasion	Femoral calcar fracture
Hematoma	Grater trochanter fracture
Sensitive nerve injury (lfn)	Acetabular fracture
Leg length discrepancy	Motor nerve injury
Subsidence less than 10 mm	Fat embolism
	Pulmonary embolism
	Dislocation
	Subsidence more than 10 mm
	Death

Figure 1: Landmarks for anterior approach incision. Antero superior iliac spine 2 cm distal and 3 cm lateral, following the middle portion of the tensor fascia lata muscle mass.

which leaves the wound at risk of being under the fold or even folded over itself when the patient adopts a sitting or upright position postoperatively, is why the authors' prefer to adjust the incision slightly curved posteriorly in the proximal part in this type of patient, and do not cross the inguinal crease.[8,9]

Lateral femoral cutaneous nerve injury

The most frequently reported complication following DAA is this sensitive nerve dysfunction (2.8%).[6] The injury mechanism relates to the dissection under the skin incision and retractor placement during the acetabular reaming. The lateral femoral cutaneous nerve (LFCN) arises approximately 11 mm laterally from the space between the sartorius and TFL muscles or from the sartorius substance. Matta described a modification to the classic Hueter approach, which involves approaching the deep layers from within the sheath of the TFL. A significant amount of the risk of an LFCN injury is reduced by staying within it. The LFCN is in a more medial sheath until it branches to innervate the cutaneous area of the upper lateral thigh, which usually occurs distal to the area of the incision. If the incision is extended distally for any reason, the safety of these distal branches may be compromised.[10]

It is uncommon for a patient to present persistent meralgia paresthetica, and cases due to iatrogenic causes typically improve within three months. Conservative treatment aims to reassure the patient and find measures to ease pressure and discomfort in the nerve and groin area. Aside from icing the affected area, anti-inflammatory medication, local lidocaine, and gabapentin or pregabalin may all be beneficial.

Circumflex vessels

The ascending branches of the lateral femoral circumflex arteries are exposed during the standard exposure for THA with the DAA *(Figure 2)*. These vessels are located

below the TFL's deep fascial layer, so it is essential to dissect it carefully, using a blunt dissector, for example. Inadequate identification ligation and coagulation of these bundles can result in significant bleeding during and after the procedure. These vessels consist of a variable-length leash of vessels and are typically visible in the center of the incision. Usually, ligatures and routine electrocauterization are sufficient to prevent and stop the bleeding from these vessels. An increased risk of postoperative hematoma development can result from inadequate hemostasis.[11]

Muscle injury

Soft tissue retraction is necessary for the correct visualization of the structures for THA. As a result, incorrect placement of retractors, wrong direction, or overzealous retraction may cause shearing damage to the TFL, rectus femoris (RF), or both. This can be avoided by utilizing specialized retractors (deep blades with curved sides) developed for minimal-incision surgery, meticulous attention to the placement of retractors, and the force and direction of retraction. If performed carefully, minimal damage to both muscles will occur with routine exposure to the DAA THA.

The author's preferred retractor is the Beckman-Adson, used solely in most surgeries and is placed parallel to the fibers of the TFL and RF. For obese and muscular patients, we utilize a modified Charnley hip retractor for its deeper blades, protecting the TFL belly muscle with gauze between the retractor and the muscle.[12]

As for capsular exposure, several authors prefer a referred capsulotomy, sometimes involving releasing the reflected head of the rectus femoris to improve exposure. This way, the capsulotomy between the retractor and the muscle belly can also be used. Special sets of various retractors have been developed for acetabular exposure.[13]

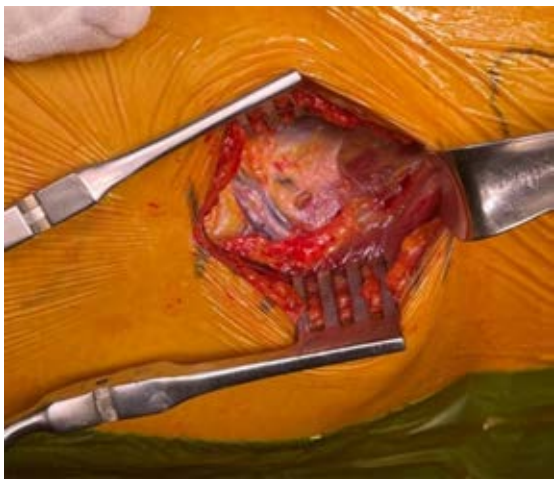

Figure 2: Lateral circumflex vessels that must be ligated or coagulated to avoid severe bleeding during or after the surgery.

Femoral neurovascular bundle injury

There are two key moments when the femoral neurovascular bundle could become injured. During the initial approach, not identifying the sartorius muscle and confusing it with the TFL will force a medial dissection of it, which will cause us to enter the femoral triangle. One possible cause is if the sartorius is mistaken for the TFL at the initial outset of the procedure.

Dissection will then fall medial to the sartorius and enter the femoral triangle, with the inherent risk of damage to the contents of the triangle. The key here is the identification of the TFL, which can be identified initially by being the most lateral belly muscle and its distinct white fascial sheath that visibly thickens as it progresses laterally toward the fascia over the gluteus medius. These landmarks can help to confirm the correct location of the TFL and subsequent placement of the fascial incision.[14,15]

Secondly, injury to the femoral nerve can also occur through the incorrect placement of retractors. When placed too deep and over the anterior rim of the acetabulum, the femoral nerve can be inadvertently compressed, leading to neuropraxia. In our series, we had a 90-year-old female patient with femoral arterial thrombosis, which required emergency surgical treatment. Again, keeping retractors immediately intra- or extracapsular is crucial to avoid compression. Staying immediately adjacent to the bone and capsule at the anterior acetabulum's midpoint is the best prevention method.

Access-related complications

Reaming and cup positioning

Cup orientation and preparation are challenging when first starting to use this approach if the surgeon is used to performing THA with the patient in a lateral decubitus position. In some cases, only a limited view of the anterior acetabular wall can be obtained, making cup placement more difficult, especially concerning the assessment of reaming. The reamers are introduced over the anterior femoral shaft with the patient in the supine position. Great caution must be used to avoid levering the reamer on the femur, as doing so could lead it to move anteriorly and risk reaming away the anterior wall. Also, cup version and abduction angles are best determined relative to the native pelvis and can be easily determined by palpating both anterior superior iliac spines. Having the patient in the supine versus the lateral decubitus position is a definite advantage in such determinations. A common error is to insert the cup with too much anteversion inadvertently. There is a tendency to hold the cup inserter too vertically, which imparts excessive anteversion to the component relative to the native pelvis. The use of fluoroscopy when first learning the procedure will avoid these issues and its position during the reaming and cup insertion. The image intensifier should be placed

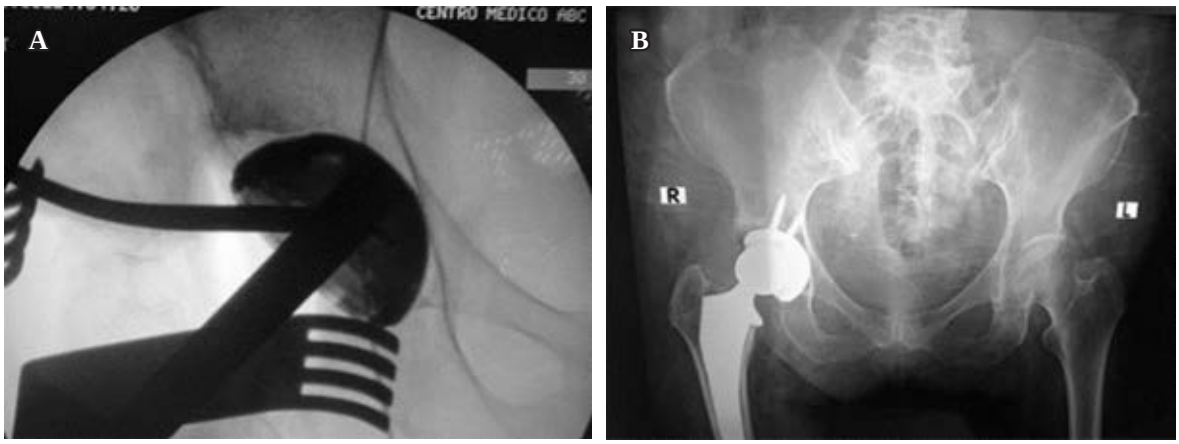

Figure 3: A) Cup insertion with an inadequate X-ray view. **B)** Resultant verticalization of the cup.

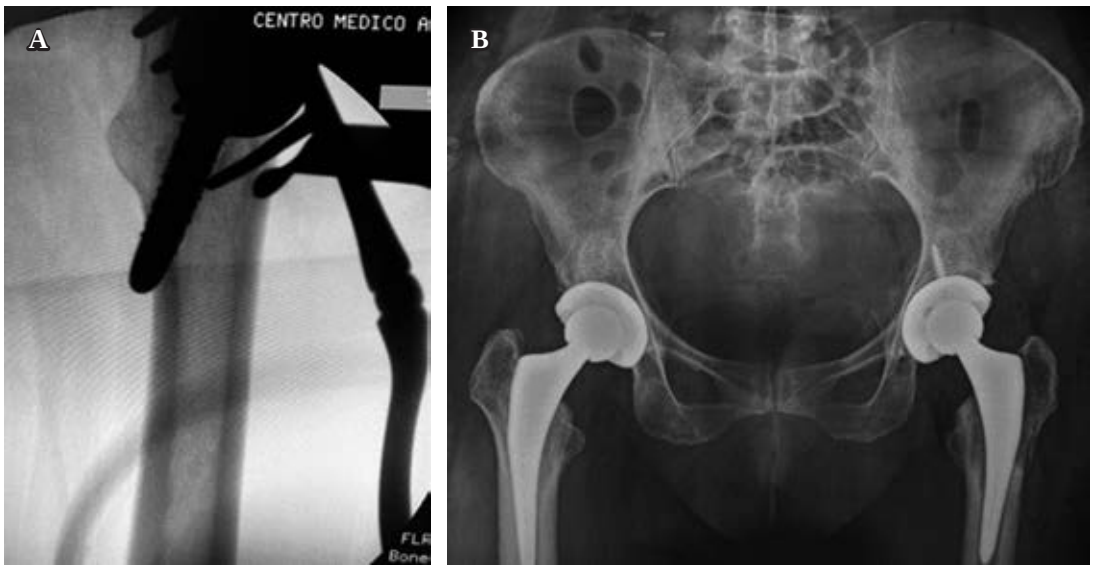

Figure 4: Lateral femoral cortex perforation. X-ray taken to verify a resistance change during femoral canal preparation. **A)** Lateral cortex perforation fracture not compromising the stem stability. **B)** postoperative anteroposterior (AP) pelvis X-ray

and positioned, supervised by the surgeon to ensure the correct images match the ap pelvis projection according to the obturator foramen on the screen. Sometimes it is necessary to angle the C arm 10 degrees caudally to obtain the matching image. The position of the C arm must be reevaluated several times during the surgery to avoid a false anteversion view and subsequent malpositioning of the cup[16,17] *(Figure 3A-B)*.

Femoral perforation and stem positioning

Due to the nature of the approach, it is difficult to obtain direct, straight access to the femoral canal. A straight view down the canal is usually not possible. Thus, there is the potential to implant the femoral stem in a varus or an anterior-to-posterior direction. This mispositioning can be avoided using the appropriate implant and broaching instrument handles designed explicitly for a DAA approach. The ideal implant has a reduced lateral shoulder that avoids needing to ream or broach significantly into the greater trochanter region while still being able to seat the stem in a neutral position.[18]

A more severe complication is the broaching-related perforation of the femoral cortex as a result of improper broach location *(Figure 4)*.

One must be aware of the femur's situation because a posterior perforation translates into a perforation of the lateral femoral cortex (extreme varus) when the femur is 90° or more externally rotated during preparation. Superior soft tissues can occasionally direct the broach in this direction.

The traction table enhances this exposure by hyperextension of the hip. When the traction table is not used, it is essential to perform appropriate soft tissue releases around the femur osteotomy to obtain a good

view of the femoral canal. The releases usually include piriformis and a partial detachment of the posterior capsule. Intraoperative imaging should be done when any concern exists to ensure proper implant or broach position. Short, curved stems are preferred over standard straight ones; thus, less stress is transmitted to the greater trochanter, thus dismissing fracture risk.

Intraoperative fractures

Intraoperative femoral or acetabulum fractures must be addressed. Femoral fractures could occur as with any other surgical approach for THA during stem insertion, and these injuries can be divided into two types: calcar or greater trochanter fractures. For the anterior approach, the reported rate ranges between 1.0 and 2.2% in multiple papers, with a little over half requiring fixation. Calcar fractures should be treated with cerclage and greater trochanter fractures with observation[19,20] *(Figure 5)*.

Using a traction table for the DAA THA has been associated with injuries other than to the hip region. Matta reported three ankle fractures using the PROfx table (Orthopedic Systems Inc., California).[2] These injuries can be avoided by closely monitoring the torque applied to the ankle and tibia and applying rotation through the ankle and knee by an assistant, during dislocation and femoral preparation. Using the traction table at the authors' center has not led to ankle fractures, using Hana (Mizuho, CA) and the AMIS special table (MEDACTA International). The fractures reported in the literature have occurred during the procedure, even in the first months afterward. In detail, in the latest reports on the DAA, these complications have yet to be reported lately because of changes in the technique and equipment.[21]

Pudendal neuropraxia

Pudendal nerve palsy is a potential complication while applying traction with any fracture or special table.

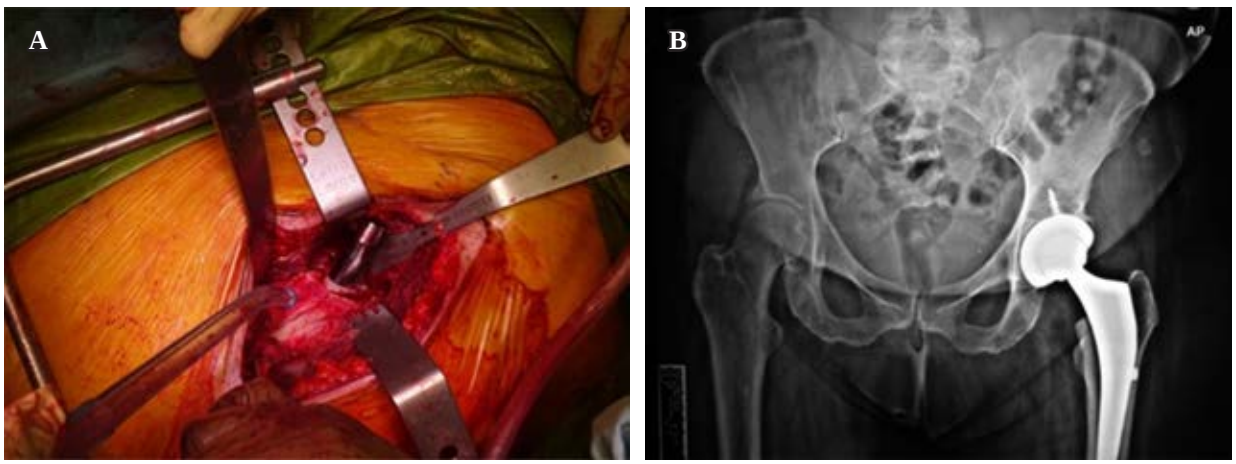

Figure 5: A) Calcar fracture during femoral stem insertion. (Pointed with the suction device). **B)** Fracture cerclage with cables, postoperative anteroposterior (AP) pelvis X-ray.

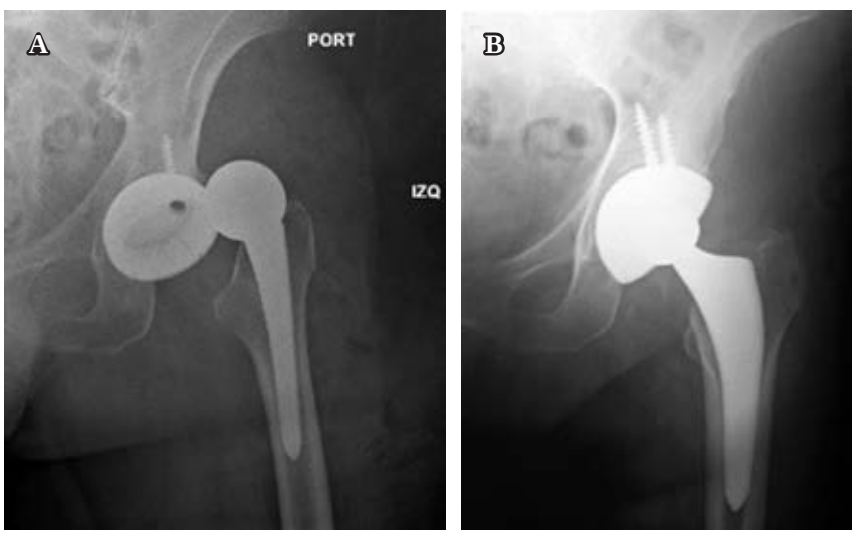

Figure 6:

A) Anterior dislocation due to over anteverted cup. **B)** Revision with a dual mobility cup.

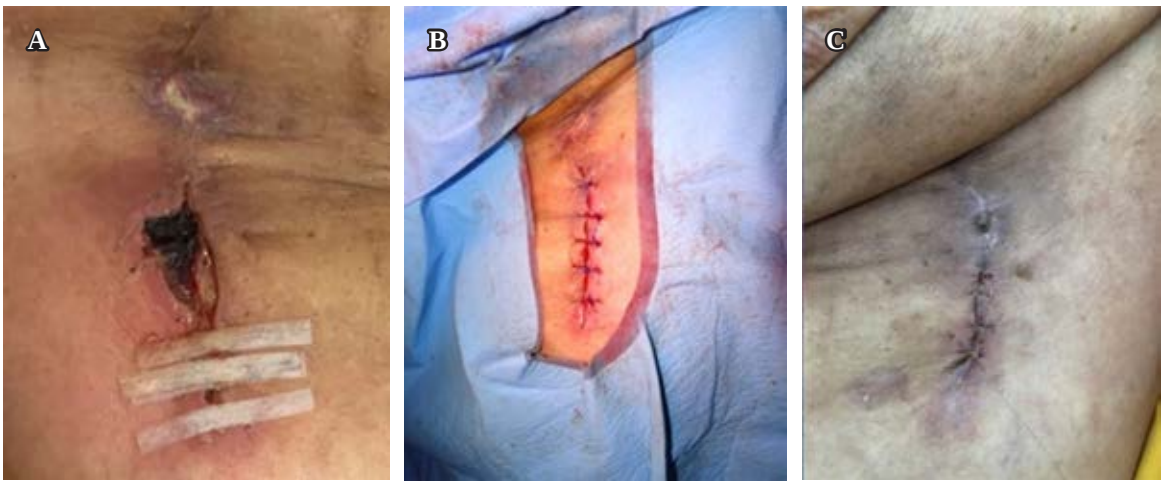

Figure 7: Wound infection. **A)** 10 days postop. **B)** Surgical debridement. **C)** 21 days after debridement.

Although no published examples of this injury with DAA have been published, it remains a possible injury, especially with extended surgery and significant traction.

Postoperative complications

Postoperative complications are similar for this approach to any other THA approach.

Early postoperative complications

Specifically, the three main early complications are dislocation, infection, and periprosthetic fractures. Early dislocations, as with any other approach to the hip, are usually a product of component mispositioning. Unless the acetabular or femoral components have been considerably retroverted upon implantation, dislocations following the DAA are typically anterior. Due to the musculature not being detached posteriorly or anteriorly, as long as the components are well positioned, it is postulated that this approach enhances inherent stability compared with other approaches. Reported dislocation rates reported in the literature were 0.96 to 1.5%. These rates are significantly lower than the rates generally quoted for other approaches[22,23] *(Figure 6 A-B)*.

In some cases, an infection could be related as part of the wound complications, and in very few cases, surgical management is required. Periprosthetic infection is a catastrophic complication. It should be resolved according to standard protocols depending on the presentation and diagnosis, often requiring surgical management with implant retention or exchange in one or two stages. Wound problems are one of the most common complications related to the anterior approach, and superficial wound breakdown can occur early in the postoperative period *(Figure 7)*. Meticulous care should be taken with hemostasis at the end of the procedure because the only formally closed layer is the superficial fascia of the TFL. We use continuous absorbable sutures to ensure a good seal after any bleeders are coagulated.

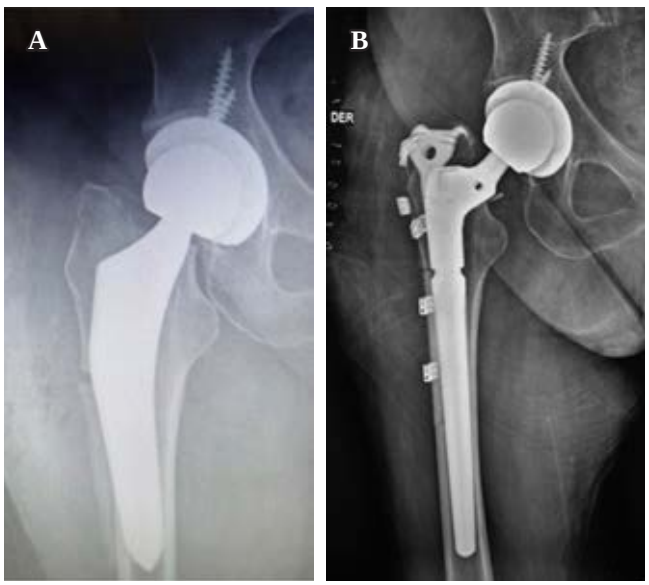

Figure 8: A) Immediate postoperative fracture with stem loosening. **B)** Emergency revision with implant exchange and osteosynthesis with trochanteric plate and cables.

A wound hematoma formation in the DAA could be the result of a direct bleeding source, such as an inadequate ligation of the external circumflex vessels or the posterior circumflex vessels that could be damaged during the femoral neck osteotomy of the tensor fascia lata muscle injury, this bleeding may be greater than in other approaches. Direct skin damage during femoral reaming is expected at the beginning of the learning curve. In obese patients, the incision must be large enough to prevent contact with the reamer with the soft tissues.

Postoperative fractures can result from direct trauma and should be treated according to the classification and management of periprosthetic fracture protocols. Some non-

identified fractures could be produced during the procedure and present in the former days as complex, unstable fractures with stem compromise, minor or severe subsidence that could need former revision and stem removal and exchange *(Figure 8)*.

Uncommon complications

As in other procedures, we have found rare complications, some directly related to the approach and others to patients' medical conditions. One 58 years old female patient who had previous bariatric surgery and subsequent skin and fat resection had a remaining lack of sensitivity area on the anterior thigh close to the incision used and had a second-degree burn after local heat placement in the immediate postoperative days with deep infection not involving the implant that required multiple debridement and skin grafting.

A 78 female with severe groin pain and femoral nerve palsy ten days after surgery in whom, we identified and then reported an iliopsoas hematoma as the pain cause. After discharging multiple other causes of the pain's possible origin, she was treated conservatively. We attribute that it was the result of a muscle tear injury during the procedure in combination with the effect of anticoagulant prophylaxis, which is routinely used in THA.[24]

Conclusion

The anterior approach presents situations, and complications that are similar to those seen in conventional approaches, significant complications such as surgical wound infection, dislocations, and trans-surgical fractures are described in the literature with a similar incidence as other approaches, so we do not consider relevant to describe more of them in this article.

The DAA is very useful and rewarding for the patient and the surgeon, reducing the injury of trans-surgical anatomical structures. A trained hip surgeon should have no significant difficulty migrating from a lateral or posterior approach to the DAA. There is extensive literature about the learning curve, especially in training centers for residents and fellows; this curve could be initially applied to any approach, and the DAA does not represent a challenge beyond usual.

References

1. Knight SR, Aujla R, Biswas SP. Total Hip Arthroplasty - over 100 years of operative history. Orthop Rev (Pavia). 2011; 3(2): e16.
2. Matta JM, Shahrdar C, Ferguson T. Single-incision anterior approach for total hip arthroplasty on an orthopaedic table. *Clin Orthop Relat Res*. 2005; 441: 115-24.
3. Kennon RE, Keggi JM, Wetmore RS, Zatorski LE, Huo MH, Keggi KJ. Total hip arthroplasty through a minimally invasive anterior surgical approach. *J Bone Joint Surg Am*. 2003; 85-A Suppl 4: 39-48.
4. Eingartner C. Current trends in total hip arthroplasty. *Ortop Traumatol Rehabil*. 2007; 9(1): 8-14.
5. Barnett SL, Peters DJ, Hamilton WG, Ziran NM, Gorab RS, Matta JM. Is the anterior approach safe? early complication rate associated with 5090 consecutive primary total hip arthroplasty procedures performed using the anterior approach. *J Arthroplasty*. 2016; 31(10): 2291-4.
6. Hart A, Wyles CC, Abdel MP, Perry KI, Pagnano MW, Taunton MJ. Thirty-day major and minor complications following total hip arthroplasty-a comparison of the direct anterior, lateral, and posterior approaches. J Arthroplasty. 2019; 34(11): 2681-5.
7. Sariali E, Leonard P, Mamoudy P. Dislocation after total hip arthroplasty using Hueter anterior approach. *J Arthroplasty*. 2008; 23(2): 266-72.
8. Fernández-Palomo LJ. [Uncemented total hip arthroplasty by anterior approach. Report of the first 50 cases]. *Acta Ortop Mex*. 2021; 35(1): 17-22.
9. Goldberg TD, Kreuzer S, Randelli F, Macheras GA. Direct anterior approach total hip arthroplasty with an orthopedic traction table. *Oper Orthop Traumatol*. 2021; 33(4): 331-40.
10. Matta JM, Ferguson TA. The anterior approach for hip replacement. *Orthopedics*. 2005; 28(9): 927-8.
11. Totlis T, Paparoidamis G, Terzidis I, Piagkou M, Tsiridis E, Natsis K. Surgical anatomy of the lateral circumflex femoral artery branches: contribution to the blood loss control during hip arthroplasty. *Annals of Anatomy - Anatomischer Anzeiger.* 2020; 232: 151566.
12. Mast NH, Laude F. Revision total hip arthroplasty performed through the Hueter interval. *J Bone Joint Surg Am*. 2011; 93 Suppl 2: 143-8.
13. Diego-Ball D, Cabal AA. [Anatomical description of the anterior hip approach: safety and effect for total arthroplasty]. *Acta Ortop Mex*. 2020; 34(2): 123-8.
14. Christensen CP, Karthikeyan T, Jacobs CA. Greater prevalence of wound complications requiring reoperation with direct anterior approach total hip arthroplasty. *J Arthroplasty*. 2014; 29(9): 1839-41.
15. Jahng KH, Bas MA, Rodriguez JA, Cooper HJ. Risk factors for wound complications after direct anterior approach hip arthroplasty. *J Arthroplasty*. 2016; 31(11): 2583-7.
16. Mohan R, Yi PH, Hansen EN. Evaluating online information regarding the direct anterior approach for total hip arthroplasty. *J Arthroplasty*. 2015; 30(5): 803-7.
17. Buller LT, Menken LG, Hawkins EJ, Bas MA, Roc GC, Cooper HJ, et al. Iliopsoas impingement after direct anterior approach total hip arthroplasty: epidemiology, risk factors, and treatment options. *J Arthroplasty*. 2021; 36(5): 1772-8.
18. Haversath M, Lichetzki M, Serong S, Busch A, Landgraeber S, Jager M, et al. The direct anterior approach provokes varus stem alignment when using a collarless straight tapered stem. *Arch Orthop Trauma Surg*. 2021; 141(6): 891-7.
19. McGoldrick NP, Cochran MJ, Biniam B, Bhullar RS, Beaulé PE, Kim PR, et al. Can we predict fracture when using a short cementless femoral stem in the anterior approach? *J Arthroplasty*. 2022; 37(8): S901-7.
20. Luger M, Feldler S, Pisecky L, Klasan A, Gotterbarm T, Schopper C. Periprosthetic femoral fractures in cementless short versus straight stem total hip arthroplasty: a propensity score matched analysis. *J Arthroplasty*. 2023; 38(4): 751-6.
21. Connolly KP, Kamath AF. Direct anterior total hip arthroplasty: Comparative outcomes and contemporary results. *World J Orthop*. 2016; 7(2): 94-101.
22. Watts CD, Houdek MT, Wagner ER, Sculco PK, Chalmers BP, Taunton MJ. High risk of wound complications following direct anterior total hip arthroplasty in obese patients. *J Arthroplasty*. 2015; 30(12): 2296-8.
23. Foissey C, Batailler C, Fary C, Luceri F, Servien E, Lustig S. Transitioning the total hip arthroplasty technique from posterior approach in lateral position to direct anterior approach in supine position-risk factors for acetabular malpositioning and the learning curve. *Int Orthop*. 2020; 44(9): 1669-76.
24. Fernández Palomo LJ, González Pola R, Castillo Vázquez FG. Iliopsoas hematoma after total hip arthroplasty using a minimally invasive modified direct anterior approach: a case report. *JBJS Case Connector*. 2022; 12(1).